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ECONOMIC GROWTH AND DEVELOPMENT

HEARING

BEFORE THE

COMMITTEE ON THE BUDGET
UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

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ECONOMIC GROWTH AND DEVELOPMENT

WEDNESDAY, MARCH 9, 1988

U.S. SENATE,
COMMITTEE ON THE BUDGET,
Santa Fe, NM.

The committee met, pursuant to notice, beginning at 9:12 a.m., at City Council Chambers, Santa Fe City Hall, Santa Fe, New Mexico, Hon. Lawton Chiles (chairman of the committee) presiding.

Present: Senators Chiles, Domenici, and Bingaman.

Staff present: Kim Wallace, senior analyst for education, training, employment, and social services.

For the minority: G. William Hoagland, staff director; Carole McGuire, director of appropriations activities; and Michelle Mrdeza, senior analyst for human resources.

OPENING STATEMENT OF CHAIRMAN CHILES

Chairman CHILES. Good morning.

I am Lawton Chiles, and I am pleased to be here today in the Land of Enchantment with two men of achievement, my good friends Pete Domenici and Jeff Bingaman.

Pete served as chairman of the Budget Committee, and I had a chance to serve under his tutelage for some 6 years, and I have come to know him very well. I understand how much he cares about the American role in the field of science and technology.

But, somehow, I'm not surprised that New Mexico has such a rich bipartisan tradition in carrying out scientific research.

Thirty years ago, Senator Anderson, a Democrat, was chairman of the Joint Atomic Energy Committee, and later chaired the Senate Aeronautical Space Sciences Committee.

Sixteen years ago Harrison Schmitt, a Republican, was the last man to stand on the Moon. He went on to devote his entire Senate term to space and science issues. Today, New Mexico has a bipartisan commitment to the scientific excellence in achievement.

Senator Domenici knows the budget inside out. Jeff Bingaman is the Senate's fresh and vibrant voice for American advancement in a competitive world. He chairs the Defense Industry and Technology Subcommittee, and knows what it takes to keep our armed forces strong. As chairman of the working group on economic competitiveness, he's been a champion for basic research, technology and education.

I have taken this time to talk about New Mexico's past and present because the Nation is facing a very demanding future, and while we face it from a position of strength, the rest of the world has grown stronger and we have to do the same.

There's certainly plenty to do. We have a huge budget deficit. We also have a heavy responsibility to make a wise investment in the areas where dividends are paid in strength. We have to do better in education.

Our graduation rates and scholastic aptitude tests have remained flat for some 5 years. It was reported 2 weeks ago that American students in the 5th, 9th and 12th grades did poorly, when compared with students in 16 other countries, in subjects like biology, physics and chemistry.

Our elementary students seem to be doing worse in the 1980's than they did in the 1970's. High school seniors across the Nation aren't doing much better now than they did 10 years ago.

American science sets the standard for the modern world, but today American students are short of basic skills. If this country intends to hold its post as the science pacesetter for the world, we certainly have to reach our children right now. We need to set their minds on fire with the possibilities that education can bring. We have to do it, because it's the light from that fire which must light our future.

We have big choices to make. The Senate Budget Committee has come to New Mexico because your laboratories are the cradle for the breakthroughs of tomorrow. We need to hear about the obstacles as well as the opportunities. We have to keep our children in school, and not just long enough to graduate, but interested enough to excel.

So, I am delighted to be here today with two of my very close friends and two of the outstanding Members of the U.S. Senate, with whom I have the opportunity to co-sponsor science related legislation.

I want to thank the city council for being so kind in helping us set up this hearing, and, certainly, Senator Domenici and his staff. Joe Murphy does such a great job of helping me while I'm out here, and I am so pleased with that.

OPENING STATEMENT OF SENATOR DOMENICI

Senator DOMENICI. Thank you, very much, Mr. Chairman.

Let me say just as a matter of personal privilege—obviously it doesn't have a lot to do with the substance of this hearing—that I have been in the Senate 15 years now, and I just want to share with my New Mexico friends that one of the real rare privileges that I have had was to become—I hope he agrees—a close personal friend of Lawton Chiles.

I have been to his State of Florida when I was chairman of the Budget Committee. I have to confess that we had at least two purposes in mind. One was to have a hearing, and the other was that I wanted to get to know him better and to know his State. We accomplished both in style.

Not too long ago he came to me and said, "I would like to go to your State. My wife would like to visit Santa Fe. She likes art."

And he knows a little bit about that. He is also somewhat worried that she may get so attached that he may become part New Mexican, at least be here part of some years.

He surprised me by moving up his date of arrival last Friday night. He saw me in the halls and said, "I don't think there's much going on in Florida." I can say that now because he isn't running for reelection.

He also said, "The weather in Florida is not so good this weekend, so I'm going to New Mexico."

So he has been here with his marvelous and lovely wife, Nancy's, and my good friend since last Friday night. Frankly, I think we've almost got a new citizen. Maybe his wife will come here to live. If he doesn't want to come along, I am sure we can have at least one.

I understand that they have spent a great deal of time seeing what New Mexico is really all about. I hope that after the hearing is over today, he will see a bit of the science part of New Mexico. He has seen the culture, the art, the Indian-related activities and some of our history. From what I understand, he has had a very good time.

Might I just say to you, Lawton, as you leave the Senate, I'm extremely pleased that you had an opportunity to come and spend some time with us here in our State. We are very delighted to have you here today.

Having said that, I'm not going to say much more, other than, clearly, we are now beginning to understand at the national level that our future as a Nation is linked to education, science and technology. I believe New Mexico's future is also linked to this because I don't think States can operate in isolation. I think our country must grow as a whole, or none of our States will truly prosper and provide the kind of future we all want for our children.

I think we're beginning to understand that there is a tremendous relationship between the knowledge that is being accumulated in universities and national laboratories, and our Nations future. There's a tremendous relationship between education and our future.

We in New Mexico, Mr. Chairman, are extremely privileged that our Federal Government started the national laboratory systems here, for reasons unrelated to the current situation in New Mexico. One of the labs was picked by a great scientist because he lived here as a young man. Then our great Senator Anderson said, "Well, if you need more, put the engineering section in Albuquerque.

So the two great national labs came into existence. Obviously, White Sands Missile Range came into existence because there's nothing like it in the United States in terms of the capability that it provides for a missile site on land.

We think that, as a State, we have been a very good home for these magnificent facilities. When you look out there and see the kind of research and technology being applied, we hope that the U.S. Congress and executive branch of the government will begin to understand that these laboratories have a great deal to offer. I refer, in particular, to the contributions these labs make with their expertise to build on our university system and help our private

sector to compete and stay alive in these dramatically changing times.

If there's anything that is characteristic of our day, it's change that is being driven by scientific innovation and technology.

We think that we in our State stand ready for next decade or two, when that kind of activity—innovation and technology—will be the cornerstone of America's future. And we want to participate in it. Not only do we want the government's institutions here, but we also want what they actually bring to the American marketplace by way of jobs.

From the national prespective, I think that's the essence of the hearing here today: What priorities will we choose as a nation to move us in the fields of science, research and education and permit us to retain and gain on our free industrial training strength in terms of jobs and in terms of competition.

There are, obviously, many other issues involved in that simple concept of jobs for the people in our State and for Americans in the future: But I think that today you will find this State is poised and ready to move ahead in those areas.

Mr. Chairman, I am hopeful that in the remaining time you spend with us in the Senate, we can together move ahead with some of the scientific initiatives in the genome-mapping area which you have been interested in, and, clearly, in the National Science Foundation. And, yes, NASA, and NASA's work in space.

Might I close by just saying to New Mexicans, this is a very different year for priorities, because, for the first time, as our chairman will tell you, this year's budget was determined last year.

The Budget Summit agreement reached last year between the leaders of Congress and the White House established spending floors and ceilings for national defense and all domestic programs. So, this year Congress will not have the opportunity to establish spending levels for these functions of government, defense and domestic. We will stay within the numbers established by the Summit agreememt.

So according to this agreement, the domestic programs will only grow about 2 percent. This means that we will have to make some priority choices among domestic programs in terms of what grows and what is cut. I will just say that the President's budget proposal is dramatically different from years past. It has very large areas of growth in science and research including space and the space program, the National Science Foundation, and some aspects of education, including adult retraining.

The reality is that in order to increase these programs, some other programs will have to be cut, programs like mass transit subsidies. In sum, that will be the battle of the next 5 or 6 months, what domestic programs to increase and what domestic programs to cut.

I am very hopeful that we will move forward with increases in the science and research parts of the budget, everything from NASA to the National Science Foundation.

In the President's budget, the National Laboratories came out fairly well. Even though they are part of defense, I think the infrastructure that they provide for defense in the future was recognized. When they were moved from defense into the Department of

Energy they did not suffer any severe cuts. They were held rather harmless. We hope we can hold that level of spending in the appropriation process.

Thank you, Mr. Chairman.

OPENING STATEMENT OF SENATOR BINGAMAN

Senator BINGAMAN. Let me just say a few words before we start.

I want to compliment you, Lawton, also, for coming to New Mexico.

I found out very quickly after I got to the Senate that with a lot of issues that come up for discussion around there, there's always one group arguing for the politically expedient course of action, and there's one group arguing for the right course of action, as far as national interest is concerned.

I can say, without any question, that Lawton is always on the side of putting the politically expedient aside and doing what's right. That's something I have come to admire very greatly as I have worked with him.

I am sorry to see him retire from the Senate this year. I think that's a great loss to the country. He's the very best that we have in the Congress and in the country, as far as a public servant is concerned, and I do believe that very sincerely.

As far as the hearing today is concerned, we do have a great history of Federal Government support for research and technology in our State, and we've also got a less long-term history, a shorter history, of State involvement and initiatives to try to support research. I do think we have done some things right. We're going to get testimony on that.

Some of the previous Governors and administrations have certainly begun initiatives to help the State become involved and supportive of research, such as the Rio Grande Research Corridor, the Centers for Technical Excellence, which I am sure we will hear testimony on today.

This administration is working hard to do the same, and I think that's to be commended.

I believe very strongly that we have two major goals ahead of us. We need to identify the new missions that we're going to pursue through our national laboratories here in the State, the new scientific commissions, and find ways to put our resources to work on those.

And, secondly, we've got gaps that need to be bridged, gaps that are between defense-related research and commercially relevant research, which we certainly need to find better ways to bridge the gap between Federal supported research activities and State support, and local initiated research efforts.

Of course, the gap between Government funded research and private sector research, and how we get a better integration of those.

I think a lot of what I see coming out of this hearing is identifying some ways to better coordinate the economic development efforts going on at all levels of government. It's clear to everyone that the only way Government can be effective is if you've got a close coordinated working relationship between Federal, State, and local government.

I think our universities and our private sector certainly have a very major part to play in it.

So, I look forward to the testimony, and I appreciate being included in your hearing today.

Again, welcome to New Mexico.

Chairman CHILES. Thank you, very much. We look forward to having our first panel.

Governor, we are again privileged to be in your State, delighted to be here in this area, and happy to have you here, and Mr. John Dendahl, who is our New Mexico Secretary of Economic Development.

STATEMENT OF THE HONORABLE GARREY CARRUTHERS, GOVERNOR OF NEW MEXICO

Governor CARRUTHERS. Thank you, very much, Mr. Chairman. I want to welcome you to Santa Fe, and to New Mexico.

I can tell by your suntan that you have now discovered that Florida does not have a lock on sunshine and blue skies, that we have some out here.

I would like for my staff to offer you a list of real estate brokers for you to shop around and see if you can find a nice place in Santa Fe or nearby area so you can spend some more time with us after your retirement, a place that has both of our Senators, Senator Domenici and Senator Bingaman, both who are known to be advocates for scientific and technology development in our laboratories and in the State of New Mexico.

I think you rightfully focused on some of the early leadership as well in the State of New Mexico, not only political leadership, but we have had some early scientific leaders here who have helped build a scientific infrastructure that we believe, here in New Mexico, to be second to none.

We are proud of that infrastructure. It includes our national laboratories as well as our great universities.

The purpose of the hearing, as I understand it, Mr. Chairman, is to examine the Federal role in economic development in New Mexico.

The Federal Government has a large role to play in economic development, a very important role. We focus principally on our great laboratories, Los Alamos and Sandia. There is clear evidence of their contribution in terms of dollars, thousands of jobs, and revenues to this State.

We agonize with Sig and Irwin and others every time the budget process is underway, and we worry about whether you're going to cut here and there, and always applaud the cuts in Alabama and regret the cuts in New Mexico when they have to come, but we are fully understanding the budget pressure that exists in Washington, and we were very pleased with the recent negotiations, which we believe protected as much as possible, under the constraints that you're faced with in the Budget Committee, the kinds of scientific inquiry that's going on in New Mexico.

You must understand, Mr. Chairman, that I am for science, if you will allow those of us from economics to claim to be scientists.

Some others of us, I believe, were in religion, but I claim to be of a scientific bent, in having learned scientific methods, and so on.

I want to tell you that consistency in funding a program is very important to science. Even though we have the ups and downs in national economy, which we are all aware of—we are all perfectly aware of the deficit situation in the Federal Government—if we don't have consistent resources to apply to scientific inquiry, it cannot happen.

I want to tell you, also, Mr. Chairman, I am very proud of these two laboratories that exist here, and White Sands, and I would like to, because I have my two Senators here who represent our great State, would like to also remind them of the Waste Isolation Product Project, which I characterize as a Delaware Basin National Laboratory, because we are in the process, and that laboratory, is studying the effects of the deposition of nuclear waste in a salt environment.

I believe that although we do not recognize it now, because we are more interested in deposition matters, while we don't recognize that, I believe that there's a lot of scientific inquiry that needs to go on down there.

Are you suggesting, Senator, this is going to be recorded?

You can't hear me in the back?

Senator DOMENICI. No; I am suggesting that you're using such marvelous words of wisdom, we want them all to hear. [Laughter.]

Governor CARRUTHERS. We don't want them to miss that.

We are very proud of the leadership we have. You will hear today from a group that is known in New Mexico as the GTEC. Most of the members are here. That stands for the Governor's Technical Excellence Committee. Those are the leaders in our laboratories and our universities, White Sands Missile Range, and so on. I think most of the members are here.

And these people, to show you one of their contributions to our great State, these people have met over a number of years and served a number of governors, and in their meeting they have focused on two particular activities in New Mexico. One is education, and the other is economic development.

So, for many years they have called us, one or the other, and discussed these issues. I think they have been very active in my administration. As a matter of fact, we have a meeting this coming Friday to continue some work on inventory of the kinds of scientific discoveries that might be commercialized in the laboratories and the universities.

These laboratories are a very important part of our State. As you are aware, we started the Atomic business, the nuclear business here in the State, in Los Alamos, and then went on south.

But these laboratories have blazed some other trails in New Mexico. Although they might be known for their nuclear work, I would like to point out to you that they are active in other areas, such as energy other than nuclear energy. These laboratories have spent some time in coal and natural gas and some of the other energy sources.

Fundamentally, they're very good at basic science, and I have heard some of the directors say that 70 or 80 percent of what they

do is basic science, although they are known for their nuclear capability.

And then I would remind you that in terms of scientific computing capacity, we probably have as much or more in this State as any State in the United States, or perhaps anywhere in the world, and we are continuing to build that computing capacity.

I understand there's a new computer on the way to New Mexico, and that will put us over the edge. No one in the United States will have greater scientific capacity than we have.

So, the question is, how can the Feds help? The Feds are here, they are helping, they are helping every day. But there are some things we would like to suggest to the committee, to the Budget Committee particularly, that might assist us even further, and assist the Nation as well.

One, we want the labs to participate in economic development. We think it's critical to continue research and development, and we have only noticed, perhaps in the last 10, 12 to 15 months, an enthusiasm on the part of the laboratories to be more aggressive.

I think something is happening in Washington that's good for us, in that these laboratories are being encouraged to reach out to do what we call technology transfer, and we would ask the Budget Committee to emphasize that, because even though we may not land in New Mexico all the commercial ideas, I think it's somewhat of a sin to have that much science in one place and not share it with the commercial sector and with the United States, particularly as we look at the so-called technology war, our attempts to keep up with other countries, who are not more creative than we are.

I don't want to leave you that impression. I think we're still the most creative people in the world. We're just not as innovative as we should be and could be. We don't adopt these technologies as rapidly as others do. And I think we would do a much better job if the laboratories had incentives to do that, if they were encouraged to do that, to extend their ideas to research and development.

I would also suggest to the Budget Committee, Mr. Chairman, that we begin to develop systems where they extend their people. We have some of the finest scientists in the world here under the Federal umbrella, and those people could participate much more in New Mexico and in this region than they have in the past. They can do that by exchange programs with the private sector, exchange programs with our university sectors.

There are a number of ways that they can become much more involved and still respect their Federal mission and responsibility.

We were a little chagrined, Mr. Chairman, to learn that we were not given credit for the super-conductor super-collider, for having the national laboratories in this State. We think that made us much more competitive than the analysis allowed. Those two national laboratories have the capability to have been quite productive in supporting the super-collider. I don't think we were given sufficient credit for that.

Let me also encourage the committee and encourage the Congress to pass Senate bill 1480. Senate bill 1480, as we understand it, would liberalize the patent laws, would encourage joint ventures, private and public, and that could be both private partnerships as well as public partnerships.

We see some real opportunity for us to interface the national laboratories with our universities, and under Senator Domenici's leadership, and joined by others, including Senator Domenici, we have linked by fiberoptics all our laboratories with our universities, or that's in the process right now.

So we have a linkage there for a great public relationship that perhaps other States have not realized yet, and we can do a good job.

We believe the bill will expedite ideas from research to production, and, of course, that's very important to our State. And we have some areas where we think we have both a comparative and absolute advantage. That's a throwback to my economics days.

Superconductivity is something that these laboratories do very well. We believe that if you're going to focus attention on one of the national laboratories and assign a major role in superconductivity, we have a laboratory that does that.

Semi-conductors is another thing we do quite well. Sandia laboratories now has a new facility down there, sponsored by the Federal Government, which could be utilized. If you're sending directives out, I think you ought to send a directive to Sandia laboratories to do much more in superconductors.

And then a new project, in which Senator Domenici has been in the forefront, that's happening at Los Alamos laboratories.

So, as you think as a committee about sending national directives and unleashing this great sum of horsepower, we believe we already have an advantage in some of these things, and we would like for you to recognize that and emphasize that as a committee.

But we also sense that as a result of passage of this act we can do a better job in removing the barriers in relationship between the laboratories and the universities.

We see students and professors at the University of New Mexico and New Mexico State and Tech, in particular, working side-by-side with the laboratories and with private industry.

If we can get a three-way interface, as I think we're going to need in this day and in this country, we can make some giant strides in the commercialization of science that happens in New Mexico.

We have not been sitting idly by. I think Senator Bingaman recognizes that Governors have a tendency to want to promote these kinds of ideas. We have a full recognition beyond art, agriculture, great tourism, and so on.

We have some of the greatest scientific ability in the world, and we are trying to emphasize that in my administration.

We met recently with the legislature. Our legislative session—you might be interested in this—only lasts 30 days 1 year and 60 days the next, which I think is a marvelous idea for the Republicans. They just finished their 30-day session in 31 days and 10 hours, which I think is not too bad.

I asked the legislature, and they passed, a number of initiatives which I think are important to enhance this interface between the laboratories and some of our public institutions.

We, 5 years ago, set up Centers for Technical Excellence. There are five of them. The university people are there, they will describe those Centers for Technical Excellence to you, I'm sure. But what

President Reagan is talking about doing now on a national level, we did 5 years ago.

Their 5-year plan ran out. They were guaranteed 5 years of funding, but some of them were not capable of standing alone yet, so we funded them once again this year to the tune of $2.7 million.

This year we passed legislation which establishes in law a science advisor to the Governor. We are in the process of choosing a person, as you well know, in our scientific community. We hope that that person will join us, and he will serve as science advisor to the Governor, and also direct many of the programs that we have in science.

We added several million dollars this year to the Ph.D program in our universities. We feel that to become apace with the national laboratories, we need to emphasize the Ph.D program. We are doing that in agriculture, business, engineering, mathematics and physical sciences.

We developed an Eminent Scholars Program. We went to the laboratories to seek out the top scientists to join our universities as full professors, eminent scholars.

There's a long and rich tradition in universities that you have to work your way up from the bottom, and I worked my way up from the bottom to a full professor. It was a great job, and I hope some day to be a full professor again, but it is a tradition that you have to work your way up through the system.

We are asking, in the Eminent Scholars Program, that we don't worry whether they came through the system, but we give them eminent scholar, full professor status. We choose among the top scientists, the top businessmen and the top artists in New Mexico, and we share those resources with our universities, and we will be coming to the laboratories to ask for that.

We also added a considerable amount of funding for quality education, and we hope the laboratories will open their doors even further to accept our students who are undergraduate and graduate students, to work full time for the laboratories and then go to school part time.

Some of the best talent that we have graduated from our universities has spent time at the bench as well as time in the classroom, and that is advantageous not only to the laboratories and to the mission of the laboratories, but it's certainly advantageous to the students.

So, today you will hear, Mr. Chairman, from representatives of national labs, private industry, State government and institutions of higher learning, but I want to leave you with the distinct impression that science is our business. Technology development is something that we would like to do more of.

We believe we need interface among other projects in the private sector, and we would hope that as you do your work in the Budget Committee, that you will continue to encourage what we sense now as a reaching out by our Federal laboratories to join the private sectors in our State to do the job that needs to be done, not only for New Mexico but the United States.

Thank you, Mr. Chairman.

Chairman CHILES. Thank you.

Mayor, would you like to give us a statement?

Mayor LUCERO. Thank you, Senator.

Senator DOMENICI. Before the Mayor does that, can I make one observation about economics as a science? [Laughter.]

Mr. Chairman, now, you sat very still and didn't say anything about that, when the Governor talked. I thought you would at least ask him about econometric forecasting.

Governor CARRUTHERS. That is a religion. [Laughter.]

Senator DOMENICI. You got it.

Chairman CHILES. I remember well Harry Truman said he was going to hire himself a one-armed economist. He was so tired of saying, "On the one hand, this." [Laughter.]

Governor CARRUTHERS. Mr. Chairman, I am told that the definition of a economist is one that's gifted in logic and numbers, but has insufficient personality to be an accountant. [Laughter.]

Chairman CHILES. Governor, when you're in the Eminent Scholars Program, the fact that you were saying you didn't have to start from the bottom up, it may well be, but I'm going to see if I can interest my State in that and see if a retired Senator can start from the top down. [Laughter.]

Governor CARRUTHERS. Mr. Chairman, if I might be excused, I have papers I have to sign today.

Chairman CHILES. If you can stay a couple of minutes, I had some questions to ask the panel. I think we might have a couple of questions we would like to ask you.

We'll go ahead and maybe see if there's any questions to ask of the Governor.

Senator DOMENICI. Well, Governor, first, let me commend you on the economic development package that you presented to the State. I commend the legislators, also, for their support of your program. To the extent that you can, you have encouraged in your legislation a better relationship between the laboratories and the universities and are moving in an effort to try to capitalize on that research base for New Mexico.

I just wanted to make two other comments. With reference to Senate bill 1480, I thank you for your support. I do want to quickly tell the lab directors and those who have been working with us for so long on technology transfer and the university-lab relations, that we have finally completed the last draft of that bill, after just 18 months of effort and four or five sets of hearings.

We introduced the bill in its final form just last week. I hope when you look at it, particularly in regards to the issues of royalty, the exchange of professors, and independent contracts with limitations, you will find those provisions satisfactory.

I also want to thank Senator Bingaman for cosponsoring the bill. It should now go through the Energy Committee, and, with both Senator Bingaman and myself on that committee, I think we have a reasonable chance of getting a substantial portion of the bill passed.

I also want to say to you, Governor, that today we will visit part of the Los Alamos Scientific Laboratories. There's very little known about genome-mapping. That is, the scientific investigation of the entire gene system of the human anatomy, and to map it.

It's kind of strange to many people in the country to find that the major engineering talent for the mapping, the engineering and

computer talent for the mapping, is located at Los Alamos Scientific Laboratories.

The President has asked for $18 million additional for just that project. We hope in our legislation to set a national policy. With Senator Chiles', Senator Kennedy's, and Senator Cranston's help, we hope to set a national policy to proceed with investigating genome-mapping and sequencing. In my opinion, with genome-mapping we will have unlocked the mystery to literally hundreds of genetic diseases and perhaps be on our way to an era of wellness, the likes of which we have never seen.

If that occurs, once again, we may be right in the middle of it here in Los Alamos and in New Mexico.

With reference to students and our universities, I also want to compliment you for focusing on graduate students and for attempting to get an interchange between the superbly qualified laboratory people and our universities and others in New Mexico society that might be helpful in that regard.

Now, having said that, might I ask, with reference to your energy science advisor, is that now a statutory position?

Governor CARRUTHERS. Yes, it is. It was included in the legislation that reorganized economic development for tourism, so we now have a science advisor who is science advisor to the Governor and also a member of economic development for tourism, and the new name of the division is Science and Technology Commercialization.

We changed the name of Science and Technology to Science and Technology Commercialization, and that person will be associated also with that division.

Senator DOMENICI. Thank you, very much.

Senator BINGAMAN. Let me just ask, Governor. This is a question I know you have struggled with and the legislature has struggled with.

I want to first compliment you on what was accomplished this session in the legislature.

But I have the distinct impression that in order to obtain and attract the faculty we need to really make our universities world class universities in many of these scientific areas, we're going to have to significantly increase salaries.

I was disappointed we weren't able to do that to a large extent in this last session. I understand the physical constraints you and the legislature operate under.

I wonder, first, do you agree with me that significant increases in salary structure for faculty is required in our universities?

And, secondly, if it is required, what do you see as the prospects for accomplishing that kind of change in the next couple, 3 years, considering the economic situation we've got?

Governor CARRUTHERS. Yes, as a matter of fact, we focused on faculty members in this particular budget. We attempted to raise their compensation packages, I think by about 4 percent.

But, in addition, we granted to the universities the latitude this year to raise tuition without the State taking credit for it, and they can apply that additional tuition to faculty salary raises.

I understand that at least two of the universities are contemplating an increase in tuition, which will not be taken away by the State. That's an unusual procedure. It used to be, if tuition were

$25 an hour, we would take that as credit, as revenue against their expenditures, and that was just gone.

So, in effect, the legislature in the past used to set the tuition. That's generally what happened. In my proposal to the legislature, which they agreed to, we left the tuition at the same level, but we said, if you wish to go beyond that and charge additional tuition for faculty salaries and that sort of thing, good projects, you will be allowed to do so.

Again, I think at least two of the universities are contemplating from a $3 to $5 per hour increase in tuition, much of that which, I understand, will go to faculty salaries.

Our salary structure is as follows: University of New Mexico and New Mexico State are 8 to 9 percent below peer universities. I think New Mexico Tech may be 14 percent behind peer universities.

All three presidents are here. Perhaps I have the numbers turned around a bit, but we are looking for 8 to 14 percent deficit in terms of peer universities.

Senator BINGAMAN. Your position is that the 8 to 14 percent deficit, as you see the economics of the State at this point, is going to have to be made up by individual university increases in tuition rather than by State funding?

Governor CARRUTHERS. Twofold. We have approximately a 4-percent increase in compensation packages as part of the general fund. That's been taken care of.

Senator BINGAMAN. I assume other States will increase theirs on a cost of living basis similar to that.

Governor CARRUTHERS. I'm not aware of what other States are doing right now, but I would say that, depending on what the universities have been granted and what they can do, that we should catch up some this year.

But we see it as a 4-year program as well. You just can't do it in 1 year given our resources.

But we are going in the right direction. We have introduced the new philosophy of allowing the universities to take some of that responsibility themselves, by charging the students. Our students only pay about 16 or 17 percent of the cost of their education, in terms of tuition and fees.

I think it might be acceptable to visualize running that number up to 20, maybe 25 percent actual cost to the student, and the State would support the rest of it.

We are relatively low in percentage costs direct to our students in the support of higher education, so what we're going to have to do is ask our students to carry a little heavier load, and, as a consequence, that would be translated into faculty salaries and other good programs.

Senator BINGAMAN. Thank you, very much.

Chairman CHILES. Governor, you mentioned students remaining in school after completion of their studies.

Have you, at your universities, and can you tell me whether—on a national level we found it difficult to keep our science students interested in the graduate program because of the salaries offered on the outside—how to keep those young scientists involved in our national lab work?

Governor CARRUTHERS. I think it depends on the cycle, but we have gone through cycles where it was almost impossible to retain, say engineering students, because the minute they graduated, their offers too often, in other States, in California and New York, were so great.

Chairman CHILES. Our faculty and undergraduate people working in graduate work, they're just sucked away, I guess.

Governor CARRUTHERS. There's still an element of that. It depends upon the discipline and the cycles. From time to time you have too many engineers and then you have too few engineers. I cannot tell you, the university presidents can tell you, where we are in those various cycles.

But we have had some difficulty even keeping people in graduate school relative to the laboratories in New Mexico, who happen to pay fairly good wages, and as a consequence, the incentive to stay in graduate school is not strong enough to keep some of our better talent.

The Center for Technical Excellence has helped overcome that a little bit because it gives some young people an opportunity to be in the frontier of science, and we hope that we can continue to maintain those centers and give them an opportunity to make a breakthrough, which oftentimes doesn't occur.

If you go to a major laboratory, you're just one of the scientists until you work your way up on the chain of command.

Chairman CHILES. Governor, you mentioned, or one of the Senators did, the National Treasury we have in our labs, and you are fortunate to have two wonderful labs here.

As Senator Domenici knows, my State is beginning to take advantage of that through our university system and through our chancellors now beginning to interfered with that, and there are all kinds of projects that can be worked on that way.

You also mentioned technology transfer. We have failed to utilize properly this tremendous resource that we have, both in our university system, and in our labs, and to see that they cross-feed each other to produce a product that can be transferred to commercial application.

We know, we read time and time again, how our scientists like to publish, but that's the end of it for them. They want to go work on something else. Something has to be done to take that intellectual property into production. Our treaty partners love to read those publications, and how quickly they can transfer those into production.

Now I think we're beginning to catch on. You mentioned the Budget Committee needing to emphasize that. We will do that all we can, but there's no way we can emphasize on that, at this level, at the university level and State level, working on that all the time, that just won't happen. So we're delighted to see that you are interested in that. And, I am sure, I hope, our university presidents and our lab people, as well.

Governor CARRUTHERS. Mr. Chairman, having come from the academic community, there's still a resistance from those who practice science, regardless of the science, there's still a resistance, for some reason, among many of them, to move into the commercial area.

I don't know whether they lack entrepreneurial skills, or whether they're not risk takers except in their science, but for some reason we don't see many of them eager to move out.

Perhaps more of the problem is, to move out you have to give up a very well-paying, solid job you enjoy very much and go out and take a high risk in the private enterprise system.

One of the universities here that I am familiar with in our State has come up with a strategy that allows the faculty member to stay on campus, to rent space—in this particular case, I believe the university has allowed the individual to build a manufacturing facility on the campus. They happen to have a lot of acres in New Mexico, and they allowed him to build on the campus.

I think the way they worked it out with this particular scientist, even if it all becomes unraveled economically, he still has a place back at the university.

Now, if we can have more of that kind of security blanket approach, some of our scientists would step out and would become entrepreneurs. But until that happens, I'm afraid they're going to look at their salary, they're going to look at their seniority, they're going to look at their security, and they're going to continue to publish.

I have published a few times in my life, and it's kind of fun to write your ideas down and pass them around, but until it's commercialized——

Chairman CHILES. Here, again, I think the whole point you make is that we have not found a compensatory way of allowing this to happen. We don't want them all to have to go into the private sector, they don't all have to manufacture, they don't have to physically produce something.

What we need is for them to go just beyond the publication, and to try to start going to the next step, or to provide a way of making that technological transfer.

We're seeing, of course, North Carolina is doing a great job of that. They're trying to work through North Carolina State and North Carolina University.

Other States are beginning to put up an industrial park in relation to that. I don't think it all has to be hardware. I think if we can have a reward system out there, so that scientist will take just a couple of steps more rather than just a publication, and making sort of a reward for that. I think it has to be more than monetary. I think it has to be something in the scholastic area, as well.

Those are the things we need to think about.

Governor CARRUTHERS. As we look at our situation, I would just like to add that everyone is worried about venture capital so we can commercialize all these great ideas that come from the laboratory. I don't worry much about venture capital, I worry about venture capitalists.

We need in our State, and I think we need around the laboratories and universities, people who have the talent to put the deal together. You can get the money from Chicago or St. Louis or Hong Kong or somewhere else. I think we are overly fascinated with where the capital is and we are not fascinated enough with the capitalists.

These scientists need venture capitalists that they have confidence in, that When they put a deal together, it's a legitimate deal, it's a safe deal, a prudent deal.

And one of the things I think we need to talk about in New Mexico, with both university scientists and with laboratory scientists is, can we somehow apply the services of venture capitalists that they have confidence in? And then that would expedite the process.

Chairman CHILES. Governor, we thank you for your attendance here. We're going to excuse you now. I think you know that we Democrats have had a falling out with the rest of the recalcitrant Republicans. We only pick on people that are crippled. I notice you've got a bad arm, and you're also National Guard, so you qualify.

Governor CARRUTHERS. Thank you. Thank you, again, for coming to New Mexico and giving me an opportunity to talk to the Budget Committee. Thank you.

Chairman CHILES. Mr. Lucero.

STATEMENT OF THE HONORABLE RICHARD LUCERO, MAYOR OF ESPANOLA, NEW MEXICO

Mayor LUCERO. Your honor, northern New Mexico, in the letter I received from you, Senator, and Senator Domenici last week, northern New Mexico is not ignored at this hearing today.

I would have to say that economic development means different things to different people, and to us in northern New Mexico, it means the quality of life, to improve the quality of life. And, truly, that's what we're after, to improve the quality of life of the people of northern New Mexico.

It is ironic that Los Alamos, being 25, 30 miles away from northern New Mexico, from the Espanola Valley, we have close to zero percent unemployment, and here in Santa Fe, also, 20, 30 miles away from that area, we have less than 6 percent unemployment.

Yet, the unemployment in northern New Mexico is greater than 22 percent identified. But many people have given up and they say, "Why? Why am I unemployed?" So, it has to be greater than that.

And yet it's interesting to note that Los Alamos, we spend—you Senators spend in excess of $800 million at that laboratory. And just a few miles away, we cannot provide a manufacturing way in which we could provide some of the needs for Los Alamos.

Today the city of Espanola is developing an industrial park, and we hope that soon we can identify some of these companies that could identify and locate in Espanola, so that we could supply Espanola with some of its needs, and instead of transporting people all over the State at big cost, we could bring these factories to the people, that could provide the services to Los Alamos.

Another ironic thing, here in the Espanola Valley we have many areas which at this time are tremendously polluted waters, and I am sorry to say that nowhere in the United States of America should we say, "Do not drink the water." I thought that was limited to Mexico.

But, seriously, in the Espanola Valley we do have areas that have tremendously polluted water, and we have to do something

about that, because that's truly quality of life, and that's truly economic development. When we see more and more areas of the Espanola Valley, which now houses over 35—40,000 people, we know we're going to have a tremendous problem in the future if that pollution continues.

Eventually if it gets into the aquifer, I ask a simple question, how do you clean an aquifer? Totally impossible. That aquifer starts some 45 miles from here, and the city of Santa Fe is in that aquifer. And Los Alamos pulls water to those laboratories from that aquifer. So the problem is severe, and getting worse by the day.

One of the greatest assets, to me, in New Mexico is the people and the fact that they are survivors. We know they are survivors because the people of the Indian Pueblos have been here over 800 years, and the Spanish culture has been here for over 400 years. So, truly, these people are survivors, and we have to give them tremendous credit.

These are the people that build the buildings of Los Alamos. These are the people that build the buildings of Sandia, and gave us that start in technology. Because without those buildings, we really have nothing. But I truly——

Chairman CHILES. The Italians that are here are pretty persistent, too.

Mayor LUCERO. That's right. At least one of them, for sure.

Senator DOMENICI. But we have not been here 400 years.

Mayor LUCERO. But we appreciate his persistence——

Senator DOMENICI. We're newcomers.

Mayor LUCERO. Well, we appreciate his persistence in our support and our defense.

But, seriously, we have to somehow protect these survivors of 400-plus years. I come to a point where the Spanish culture of the 16th century, is very well identified and is very much a part of northern New Mexico.

But, yet, nowhere in the United States do I see where the Spanish culture of that century, of the 16th and 17th centuries, is protected and identified. That worries me tremendously. Surely, the Mexican culture is very well protected here in Santa Fe and many parts of the United States, and truly the Indian culture is, also.

But what worries me is that the precious culture of that century, that today, still, the people of northern New Mexico speak the language of that century, and still we hear the stories of our ancestors of that great history. The real explorers of the United States of America, Coronado De Sota, De Leon, Onate, De Vargas, were the ones that identified the United States of America, all the way from the——

Chairman CHILES. St. Augustine really started it. [Laughter.]

Mayor LUCERO. St. Agustine, New Mexico here, New England, and all the way to Seattle, WA.

So, surely, they have a great part to play, and we thank Stewart Udall for making a tremendous identification as to that.

But, still, we in Espanola, being the first area that was colonized in this United States of America, as to establishment of a capital by Juan Onate in 1598, feel that to improve the quality of life of the people is to use the people and their talents.

And, truly, the people have tremendous talents in pottery making of the Indian, where they take earth and they make a fantastic pot from it, where we still weave the blankets of 1598 in the Espanola Valley, where we planted apple trees then and we still have apple trees.

Unfortunately, all of this that is produced by the people cannot be marketed, because we don't have a way in which to market it.

Still I see that over half of the apples produced in the Espanola Valley, in excess of 500,000 bushels is going to the pigs to eat, because we have not had a simple technology or a way in which we can make juice out of apples and then sell it to New Mexico. But we have to bring juice and cider from Colorado, from the delta area, where they do make juice out of apples, and sell it in New Mexico. It becomes very sad.

Then we should not be surprised that we have 22 percent unemployment, because, surely, we have not supported that culture and that people with what they have to offer.

We would hope that soon the Espanola Valley could have a Plaza project started, where we would identify forever those explorers of the 15th century, of the 16th century, that explored New Mexico and the United States of America. We would truly give them a place in history forever.

We would surely identify once and for all that there was a man, his name was Popay, that led a revolution for his people, in 1680, of the Indian uprising, and surely identify it for him. From here we would bring about a way in which to market this crafts and this agricultural values that this culture produces.

One of the most beautiful things that we find is out of nature itself. Out of weeds and corn and gourds we produce a beautiful, decorative piece. Today they are marketed all over the United States, but not in Espanola, where they are produced.

So, surely, these people are survivors. They are survivors because yet today they haul their water, because what they have today is polluted. They are survivors because they are still holding on and surviving with their little flock of sheep, with their four or five cattle, horses, and the like, and still holding onto the dream they had in 1598, that this was the land of opportunity.

So I ask you to please continue to never ignore northern New Mexico, but give us an opportunity to market what we produce.

Give us an opportunity to bring people into northern New Mexico, possibly by creating a regional airport that could supply the triangle of Santa Fe, Los Alamos, and Espanola, and all of northern New Mexico in skiing and the many areas of recreation that we have in the north; by giving us and supporting us in a regional water and sewer system, to forever not have to say, "Do not drink the water," so the people do not have to haul buckets of water to take a bath. Because that is really happening today in northern New Mexico, in the Espanola Valley.

So, to me, economic development is to improve the quality of life. At whatever stage we want, we need to improve it. Thank you.

Chairman CHILES. Thank you, very much, Mayor.

Chairman CHILES. Mr. Dendahl.

STATEMENT OF THE HONORABLE JOHN DENDAHL, NEW MEXICO SECRETARY OF ECONOMIC DEVELOPMENT

Secretary DENDAHL. Thank you, Mr. Chairman.

Like Governor Carruthers, I come with remarks, a few remarks focused on advocating and encouraging the efforts that are underway to bring federally sponsored research more directly into the national economic mainstream.

I know that the origins of the Los Alamos laboratory, the Sandia laboratory, all other Federal laboratories in the defense and atomic energy establishment, started with the defense mission, very high security and classification of information, and a culture that was antithetical to sharing of data and transfer of technology into the private sector.

I also know that the national policy has changed through such legislation as the Stevenson-Weidler Act. I have seen, through my personal involvement with this process, slow but very encouraging change in the national laboratories and Federal laboratories in New Mexico.

Some of the State initiatives that have come as a result of this, you heard from the Governor about these five Centers of Technical Excellence in New Mexico's three doctoral degree graduate universities, you heard a little bit about TechNet, which is a joint private public initiative to provide high speed data communications among the universities and private sector installations.

There is a privately funded foundation called Rio Grande Technology Foundation, or RioTech. Its purpose is to facilitate technology transfer from the Federal laboratories and universities into the private sector, and to the great credit of Los Alamos National Laboratory and some of its senior fellows, there's an effort underway to establish a doctoral and post-doctoral multi-disciplinary educational facility known as the Santa Fe Institute.

I was given a briefing yesterday on an application which is being made through the Santa Fe Institute, the National Science Foundation, for a Center of Excellence in applied molecular evolution. I didn't understand all the chemistry that was told me in an hour yesterday very well, but I gather that the work that would be done in that center coordinates extremely well with a great deal of biology, microbiology and other sciences of Los Alamos laboratory, and also with the enormous computing capability that exists at Los Alamos.

The individuals that are putting this Institute together, some of them are senior fellows at Los Alamos, who are given by the laboratory time to work on efforts such as the Santa Fe Institute.

I think that both the director of Los Alamos laboratory, Dr. Sig Hecker, and the president of Sandia laboratories, Dr. Irwin Welber, who you will hear from later, are to be commended for the progress that those two laboratories are making in moving their work and the work of their scientists to close collaboration with activities outside those laboratories.

In summary, because I know the time is short, I think what is needed is reinforcement of policy from the Senate and Congress toward making these installations reach their full potential in helping the United States compete in what is a vigorous technology

effort. This means that innovative work needs to be done in two particular areas that I can identify.

One is, obviously, protecting the security interests of the United States. There's a good deal that's defense related and there has to be high security. But, on the other hand, making this taxpayer-funded intellectual property available ultimately to the private sector, which is, in fact, in this country the part of the economy most charged with competing against those economies of our rival nations and our trading partners.

Thank you, sir.

Senator DOMENICI. Let me just take a moment to address the issues you raised, Mayor Lucero.

First of all, it would be an absolute shame if we let this hearing go by without complimenting you. I believe that the issues you raised are vital, and I am firmly convinced that they don't get solved without leadership at the local level, which has the capacity to be innovative and to dream and has the fortitude never to give up.

Two-and-a-half years ago you showed me the concept of a major Plaza in Espanola. You have come a long way with that. We now see it beginning to evolve.

I would say to you, you have my full and whole-hearted support in the process of applying for and putting together a grant application. We are very hopeful it will fit within some existing program so you can get a start with some Federal assistance.

You are fully aware that a great deal of private sector involvement should take place in the development of this major Plaza for the preservation of culture and for the sale and merchandising of the crafts and art in the local area.

Also, your concept of the preservation of the Spanish culture is a very exciting one. I think you know that that is a very big dream, and that nothing happens without that, and I hope you will stay with it, because I think you're gaining support with every month that goes by. Let's just hope we can get it started.

On the potable water and sewer problem, we have already had one meeting, and a feasibility study is going on now to see how a regional kind of water and sewer system, at least a sewer system, might become feasible.

We look forward to seeing that feasibility as it evolves, with hopes that by matching up State with local and Federal Government we can have a future where that area can develop, and, as you put it so beautifully here this morning, with the quality of life being good and the people being able to retain their culture, but yet have employment.

We will do what we can, I will assure you on that. I think you know that we have started an Acequia Preservation Program, which is basically a northern New Mexico program, although not exclusively, and even in difficult budget times, we will start the program this year. We have $1.5 million ready to go to the core, and $40 million is authorized over the next 5 to 10 years, as our share.

I'm not so sure that we can keep it on an accelerated time frame of funding with the difficult problems with the budget, but we will

try to keep it on track and try to get additional Acequias preserved.

That's part of what we're talking about, but, certainly, that's not the whole answer, so from my standpoint I want to compliment you for it and let you know that that's a very important part.

Everything you have described is an important part of New Mexico's overall picture of the quality of life and economic development and prosperity, and we will do our best. It won't happen without local leaders like you, and I compliment you for that.

Mayor LUCERO. Thank you, Senator.

Chairman CHILES. Senator Bingaman.

Senator BINGAMAN. Let me just say a couple of things. I do think that the points you have made, Mayor Lucero, points up a very serious issue that has been with us a long time and will be with us in New Mexico, and that is how you bridge the gap between the high tech activity going on in this State and the situation that many average New Mexicans find themselves in, which persuade them that it's really not relevant to their lives.

We've got to find better ways to take people who grow up in our State and involve them in some of this progress and advancement. We have not done that as well as we should have in the past. I think your efforts to build the economy in Espanola are certainly commendable, and, of course, I support those.

I think that the legislation that I put in, and that Senator Domenici cosponsored, this last week, to ask the Park Service to look at what they believe should be done to help commemorate the Spanish colonization and properly interpret that for the public, I think that's a step in that direction, and I hope that's successful.

Let me also just ask one question, if I could, of John Dendahl. I pick up, as I travel around and talk to some of the businesses that are struggling to get going in this State, that a major, major obstacle that we face in translating or taking this step in technology and this research going on at the Federal level in our laboratories, taking that and turning it into private sector jobs, a major obstacle is lack of venture capital.

I am just wondering what you see as the prospect for improving that situation in New Mexico in the next year or two.

Secretary DENDAHL. I think my answer is the same as the Governor's. Capital moves in a couple of seconds over a Federal wire. The problem is the lack of capitalists, perhaps, or capitalist innovation.

I think that the more information that is made available, commercializable opportunities for research in New Mexico, the more venturers will focus on those, will come here, and will see to it that the capital is made available.

I think it's a frequently heard refrain around here, and it probably is in a great many other places, everybody thinks his or her idea is a super idea, and if they can't find a bank or a venture capitalist or some other financier for it, the natural reaction is, "Well, nobody is willing to take a risk. I've got this great idea but I can't get it funded."

The problem is, there's a long bridge between a great technological idea and the business plan and all the steps that have to be done to satisfactorily commercialize it.

We have here a technological innovation program run by the University of New Mexico, we have several business incubators which have begun to develop in New Mexico to provide that kind of assistance to those who are entrepreneurially inclined, and we have the New Mexico Research and Development Institute, which provides a combination of business plan review and a type of venture capital for funding development.

More steps like that, I think, will develop in the next couple of years.

Chairman CHILES. Thank you, very much. We appreciate you being here. Our second panel will be some of our educators. On the next panel we will have Dr. Gerald May, president of the University of New Mexico; Dr. Larry Lattman, president of the New Mexico Institute of Mining and Technology; Dr. James Halligan, president of New Mexico State University; and Mr. Samuel Vigil, President of Luna Vocational Technical Institute.

We thank you all for being here. Let me just tell you at the outset that we're running about 30 minutes behind time. If you make your statement short for us, and if you have a written statement, it will go in the record of the hearing. Brief your statement for us and give us a chance to ask questions.

So, Dr. May, we will start off with you.

STATEMENT OF DR. GERALD MAY, PRESIDENT, UNIVERSITY OF NEW MEXICO

Dr. MAY. Thank you, Senator Chiles.

Chairman CHILES. Asking the president of a university to make a brief statement is kind of like asking Senators to strike their remarks.

Dr. MAY. As an old college professor, we're used to speaking in 15-minute increments.

I appreciate this opportunity to say something about the role of higher education in economic development, and particularly as we look at the future, I don't need to dwell on the point that the future needs an industry based and an economy based on information, and higher education is in the business of creating, interpreting and designing information. So if there's ruins there, that means that higher education is a critical part of the future.

We have heard that in higher education, too, there are more and more demands on higher education in the last few years to be involved in, quote-unquote, economic development, and what our roles of the institutions in that economic development is, and what we ask ourselves. I want to simply point out that we have responded, and how we have responded, and some things that we may or may not do well.

It's no surprise that when industry is asked about the quality, the climate for industry, and for the future, higher education is always near the top of the list.

And that's for a number of very practical reasons. Clearly, the future economy will rely on the flow of highly educated people, a well-trained work force with both literate skills and specialized skills, and those come from the university.

There are sources of expertise at university that aren't available within a small company, and so the consultants at all levels of the university provide that kind of expertise to their community.

The future economy will require workers that continually renew themselves, and demographers tell us already that the future worker, the future professional, may require as many as six complete retrainings during their economic life.

Therefore, the call for continuing education, for continuing professional development, is something that every industry looks for, and they want that as proximate as possible.

The quality of life that an institution brings to the community is something that is very important, specialized health services, cultural events, and I'd have to include athletics in that. For our institution, as long as it's basketball, it's all right.

One other thing that I want to return to is the issue of technology transfer. Industry likes to be proximate to the university to speed up the transfer of technology and the transfer of ideas into the marketplace. We can no longer afford the luxury of the time line that we had in the past of moving ideas into the marketplace—and clearly the pressure is on us to be competitive in the world—or rely on that very point to speed up that process to get the ideas commercialized and useful, and sold within a very short time.

The universities have responded, and I only speak for our own institution when I say that we have done many things. Some of those have already been mentioned this morning. We have created a research park, an attractive place for industry to locate, with benefits to the proximity of the university.

We have worked very hard on policies to help the faculty in the role of entrepreneur. You have already heard the statement that faculty are not necessarily cut out to be entrepreneurs, and that may be true, but there are faculty that generate ideas. Sometimes they carry them all the way through, sometimes they don't.

We try to promote those policies so that the faculty will have every incentive to protect those ideas. We have a patent attorney, for instance, on staff who tries to identify those ideas and protect them for the faculty.

Intellectual property kind of policies that give incentives to the faculty and to the idea generators are all promoted. We encourage spin-offs. We have very liberal, and I think enlightened, policies on leave for faculty so they can start a company over a period of time.

In this State, you have also heard that we have a rich source of technology and of scientific talent in the laboratories, and so we have worked very hard and under the leadership of our senior Senator, particularly, to create the kind of mechanisms that allow us to link with these laboratories.

And we have many rich links. We have much laboratory research at both Sandia and Los Alamos. We have organizations, such as RioTech, that are devoted to the idea of bringing together the three partners, industry in the private sector, and the laboratories and the universities, in new ways of commercializing ideas.

We talked about continuing education, and providing continuing education for professional development on-site is something that every industry is now demanding. We offer about 40 courses a se-

mester on live TV to our proximity, that is, to our community, to the laboratory, so that those scientists and engineers can take courses in their own facilities. We have experimented with that on satellite, and have offered health service courses via satellite to remote communities, and we think that helps the communities also to be competitive.

One of the other common denominators of the future will be information sharing and information availability, and therein Tech-Net has been a network for data linking of all of our institutions, and in the university resides data bases that should be available to the entrepreneur in smaller communities as well as to our own community.

So I paint a picture in which I want to make the case that the university is a vital partner in this whole process and views itself that way.

I would also, though, offer a warning, to say that there's no substitute for what the university does best. The university, first and foremost, is an academic institution, and what it does best and what it should do best is provide quality educational opportunity and educational programs.

That means, in addition, competitive research. Our institution does $60 or $70 million worth of research. The Federal research at the institutions and in keeping those institutions vital. The State has also supported that through the Center for Technical Excellence, which you have heard about. Those are all important ingredients of the quality of the institution of higher learning.

Common denominators of the future are literate skills of our citizens, specialized knowledge of our citizens, and the ability to do lifelong learning, and that comes only from quality academics.

We are sometimes, as institutions, called on to respond to specific calls. For instance, in the industry that we try to attract to the State. We are partners in that, but it's very difficult for the institutions to posture themselves for those specialized kinds of partners.

The long run industry looks for communities that wish to, and are dedicated and committed to investing in the long-term rather than the short-term, and State support and Federal support of the higher educational system is ultimately, in the long run, what carries the day.

I would make another point, that in the spectrum of the creation of a new product, if you will, or new economy, or new industry, the spectrum starts at one end, the creation of the idea, and the other end of the spectrum is finally a product that goes out the door.

We are only at one end of that spectrum at the university. We are very good at basic research. We are sometimes involved in applied research, but we are somewhat good at product development or product commercialization.

So that argues for partnerships in which the university plays its part, the entrepreneurs and the technologists play their part, and, finally, industry manufacturing plays its part. We view ourselves as partners for the future in the vital multi-faceted resources for the State.

Chairman CHILES. Thank you, very much, Doctor.

Dr. Halligan.

STATEMENT OF DR. JAMES HALLIGAN, PRESIDENT, NEW MEXICO STATE UNIVERSITY

Dr. HALLIGAN. It is indeed a pleasure on my part to appear before such an esteemed group, Senator Chiles, Senator Bingaman, Senator Domenici.

My colleague has stated very well, I think, the purposes of the university, and I just want to say three things. That should give you heart.

The first thing I want to say is, universities are about students. If the Federal Government—and this is a rare opportunity on my part to get counsel to represent Federal Government—if Federal Government wants to do something about economic development, the first thing I would say is, increase student aid. Increase student aid.

Fifty percent of our students have to work while on campus. Seventy percent of the students have to have some form of aid. Do not cut student aid, increase it. That's 1-A.

1-B is, when we responded to the Sputnik challenge, we put in a whole host of fellowships. I feel the challenge of the nation now is at least as great in terms of our competitive challenge.

Point 1-B is, increase the number of graduate fellowships. The Federal Government should do that tomorrow. That will enhance our competitiveness with respect to the universities. We know that works. There's a lot of evidence that it works. When we had the Sputnik challenge, it did work.

The second point I would like to make, having spent a little bit, the first part of my life in the private sector, and the remainder with universities, I would like to emphasize the importance of a bridge-back.

If you want faculty to transfer their technology to the private sector, you must provide a bridge-back. The Federal Government should support universities in that regard.

What do I mean by a bridge-back. I simply mean that if they go out, they try their ideas and it doesn't work, they can still say, "I can go back to the university and the university will have a place for me." You have minimized the risk.

So, the first point that I made was, support the students. This is the old professor in me; you always have to repeat it three times.

The first point was more student aid, more graduate fellowships. The second point is, the government should have a program for a bridge-back.

The third point I would make is, we are oncoming a nation of city states. That, in my judgment, is not good policy. There should be additional emphasis on rural economic development.

My particular university has a special focus in this. We have obtained support from the private sector, namely Mountain Bell.

We are surprised at what the needs are. The needs are for basic infrastructure, for information regarding the streets and roads, for information concerning where the utilities are at. There should be a support from the Federal Government for rural economic development. We think that's important.

The Federal Government can play a role in that. We think it will enhance and stabilize this great democracy that we have.

In closing, I will give you my three points over again and then I will have done what all good teachers should do.

One, across the Nation you need to increase student financial aid. There needs to be additional graduate fellowships, support for students at the university level. That is the engine of economic development in our society.

Two, there needs to be a Federal program to assist universities in having bridges-back.

Three, try to minimize the trend toward city states and have a rural Economic Development policy.

I thank you very much for the opportunity to come before you.

Chairman CHILES. Thank you, Dr. Halligan.

Dr. Lattman.

STATEMENT OF DR. LARRY LATTMAN, PRESIDENT, NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

Dr. LATTMAN. I agree very much with what my colleagues have said. It gives me a rather restricted range without being totally repetitive.

I would like to concentrate, therefore, in one area where I think the universities and TechNet can be of immense help in the development of New Mexico.

The whole chain, as has been brought out, from the conception of a new idea to its production is a link by link operation which fails at its weakest link.

Approximately one-third of the start-up companies, not the Fortune 500 but start-up companies in the United States, fail, because they cannot make the transition from conception or development of a brand new idea through product development to manufacturing. Or, if they do manufacture, they cannot compete with Japan, which will duplicate the project within 3 months and undercut it.

We have very close relationships, for example, with the Institute of Technology of the University of Tokyo, which is a federally funded Japanese Government institute. They won't deal with small companies. They will deal in and transfer technology only to Mitsubishi, Toshiba, Sanyo, and the like.

Small start-up companies of 3 to 10 people do not have engineering staffs, nor can they afford engineering staffs, or the expertise to take an idea and put it into a profitable production.

One of the major problems with venture capital in many cases is the simple question, after 6 months the capitalists may say to the person actually doing the work, "Have we produced anything yet? Are we on the market?"

Commonly, if they get the answer, "We're still developing it, there are a few bugs in the system, we'll work it out, you should be in production within 1 year," the venture capital freezes. I have seen this myself happen time and time again.

I believe what we need, and the universities can be a starting point, to tie the national labs and use TechNet as the data base access.

We need the equivalent of what has been traditionally in the U.S. agricultural experiment stations, where people have gone out to help private farmers and call them engineering development stations, where the expertise and experience available at universities,

in the labs, retired people, and the like, can make vast experience and skill available to small companies at very reduced, or even federally subsidized rates, to enable those companies to move through the maze of problems associated with product development and product manufacture, so that they can be manufactured at a competitive price or the company will fail, so that they can get on stream in time, so that they are not preempted by a larger, better staffed company, and that fear of preemption is not there.

The universities could act as a focal point to gather this information, TechNet can access the data base in New Mexico, and it can be done nationally for all kinds of linkages now available.

I would say that until we overcome the weak link between concept and production, through development and manufacturing, quality control and competitive prices, our ability to have a successful, or a large number of successful start-up companies, will be much reduced, and the only companies that will be able to take advantage of technology transfer are large, well-staffed and well-equipped companies.

If that's the route we want to go, fine. If we want to have the development reach down to smaller levels in areas like northern New Mexico and the like, then we must have this, and I think the universities, in addition to everything else they can contribute, can be a focal point.

The national labs and retired people are an immense reservoir of expertise that the United States has really not tapped. In most cases, a small company—I have talked to several of the entrepreneurs, and they say they don't even know where to turn, how to get the information, how to get the help, or even to judge the quality of the help they're buying. This we have to help them with. And until that weak link is welded strong, I'm afraid the chain will break at that point repeatedly.

Thank you, very much, Mr. Chairman.

Chairman CHILES. Thank you, sir.

Sam, I understand you're handicapped like those of us up here. But also as a member of the legislature, I want you to know that when the Governor made his remarks about the short-term of the legislature and getting him out of town, I bristled a little bit. Having spent 12 years as a State legislator, I always found Governors always thought they only tolerated us to sign the check. Once in a while we had to remind them that we did sign the check. So I want to give you equal time.

STATEMENT OF MR. SAMUEL F. VIGIL, PRESIDENT, LUNA VOCATIONAL TECHNICAL INSTITUTE

Mr. VIGIL. Thank you, Mr. Chairman. You have to realize that the Governor of New Mexico is relatively new on the scene, so we have to consider those things.

Chairman CHILES. Yes, sir. We have to nurse him along a little bit.

Mr. VIGIL. Have to nurture him, yes.

Mr. Chairman, and, of course, Senators Domenici and Bingaman, it's indeed a pleasure for me to be here.

Of course, I am out of my league with these gentlemen here, but perhaps I can speak to the issue of postsecondary education. My personal experience is more in the area of 2-year education, 2-year course education.

But I'm not necessarily going to address that. I am going to speak, just basically, for the sake of brevity, on four topics, Mr. Chairman, with some points to those topics. I would like to kind of—probably, I would repeat some of the things that have been said, but let me go through the process, Mr. Chairman, if I may.

The first thing that I would like to address is the value of public investment in education. There are certain points, and the first one would be that public investment in education creates wealth and increases productivity.

Second, education should be viewed as the real and productive investment in human capital that it is, and certainly not just a social program or activity.

Third, the provision of a sound educational system is one of a handful of investments that the public sector makes in our economy.

Fourth, this investment in education must be continuously fine-tuned to reflect the changing times and thereby produce a higher rate of return.

Fifth, the basic business of State government, in my opinion, is to provide quality education to its population, maintain their infrastructure, and create a stable fiscal environment.

These I consider to be the most powerful economic forces under State control.

Last, the kind of business industry that we want to attract to New Mexico needs a well-educated labor force and an adaptable local education and training system.

To achieve economic expansion, which is a laudable goal, public officials must increasingly expand public investment in human capital.

The second topic I would like to address is the roles for postsecondary institutions and economic development, Mr. Chairman.

We must increase the understanding and awareness of the population. We must develop and maintain educational programs which increase citizens' understanding of an internationally competitive economy and knowledge of other cultures, language and social systems.

Postsecondary institutions should be concerned about the development of human resources, and provide job training to meet the needs of the economy for skilled and adaptable labor. Such programs may meet short-term needs for specific training or retraining as well as long-term needs for a better educated work force.

Technical assistance should be also a great concern of the roles of the postsecondary institutions. We must provide programs which help regional and local businesses and industry to apply existing technology and knowledge to practical real world needs.

Technology transfer is something that has been mentioned. Postsecondary education should, of course, help transfer newly developed technology to industry and knowledge to keep industry competitive.

In reference to basic research, postsecondary education should develop new knowledge to help improve industrial competitiveness.

There should be a concern for the support of entrepreneurship and new business development, sponsorship and cooperation with business incubators, research parks, and other means of encouraging new technological development.

There should be a concern about the promotion of international trade. Assistance to business and industry in understanding and competing effectively in international markets should be one of the roles postsecondary education plays.

The one that has been repeated time and time again, of course, is the maintenance—and also, incidentally, mentioned by the mayor from Espanola—the maintenance of a high quality of life.

The role of postsecondary education should be to address this issue of a high quality of life, assistance to the locality and region in attracting business and industry by providing a diversity of quality education, social and cultural advantages, to employees and their families.

The third topic has reference to the factors to consider in looking at the roles of postsecondary education and economic development.

We should remember that different kinds of institutions have different roles in unique ways in which they can contribute to economic development. Mission and location both play a significant part in determining an institution's appropriate role.

The role of a postsecondary institution should be based not only on an understanding of the international marketplace, but even more, on sound knowledge of the needs of existing and potential business and industry in the State and locality.

The basic quality and capacity of the institutions, in terms of their faculty, equipment and facilities, are as important to long-range economic development and competitiveness as are special programs which focus on particular economic development needs.

The last topic is, of course, of particular concern to these issues as they relate to New Mexico. You must keep in mind, Mr. Chairman, that New Mexico ranks 46th among the 50 states in personal per capita income.

New Mexico needs to diversify its economy, both to forestall the wide economic swings that result, whether they be the result of international market conditions or perhaps even Federal spending, and to develop an economic base in tune with the needs of the international economy within the ability to provide jobs for its citizens.

The last general issue, Mr. Chairman, in reference to particular concerns of New Mexico, is the issue of the minority population in the United States. As we know, and certainly in New Mexico, minority populations are growing more rapidly than is the overall population.

In New Mexico, minority ethnic groups will be a majority of the population before the year 2000. Minority populations participate both in education and in the economy at a lower rate than does the population as a whole.

Lack of education. If I may, Mr. Chairman, the obvious point is that lack of education is a single best predictor of unemployment.

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Minority participation in postsecondary education in New Mexico, while higher than for much of the country, is significantly lower than for the non-minority population.

If rates of participation in education for minority students do not increase, the education, and probably also employment level in New Mexico will drastically drop.

Finally, on this point of New Mexico then, all the postsecondary institutions in New Mexico have particularly important roles to play in attracting, retaining and graduating minority students. This will broaden employment options for its citizens, improve their income potential, and increase the State's opportunity for attracting business and industry based on an educated and skilled labor force.

Thank you, Mr. Chairman.

Chairman CHILES. Thank you, very much.

Senator Domenici.

Senator DOMENICI. Thank very much, Mr. Chairman. Let me start with our last witness first.

Sam, let me thank you for your testimony. I am convinced that while you have stated a very significant situation with reference to the percentage of the new people in the work force and their relationship to minority status in New Mexico, as we move through these next couple of decades, I hope that you know that that has now been transferred to a national scene by those who look at demographics.

The numbers are startling in terms of the next 25 years, particularly with regard to minorities. Minorities have to be well-educated and trained in a manner relevant to the economy, or not only will New Mexico suffer, but the Nation will suffer as well.

There is an incredibly high portion of new jobs that have to be filled by minorities. There will be no one there to fill them if this population is not educated and trained in a relevant manner.

The situation we face is now reaching astronomic proportions especially when we look at the job profile of the next 25 years. Twenty percent of the jobs will be filled by minorities.

So you're on the right track. New Mexico is an important training ground for people like you to speak out on.

Can I ask you a question with reference to the U.S. Department of Energy's minority assistance program at your vocational school? Not a lengthy explanation, but I know this program is working and it's important that we maintain it.

Could you put it in a quick mention of how important it is to your school?

Mr. VIGIL. I think if I could put it in the context of, this would be in the type of a microeconomy approach, Senator. As I think we all know, there are a lot of experts in reference to a microeconomy. We put a lot of money into a lot of big things.

This is an example of a little project with a little bit of money, approximately half a million dollars for the entire country, for some of these institutions that deal in this minority program, of which the institution I represent is one of them.

This has helped tremendously, Mr. Chairman and members of the Senate, to address the needs of minority students, in trying to

get them particularly prepared in the area of energy and those areas that are technically relevant and significant to the country.

It has been tremendously beneficial to us. We have had this program going on for close to 5 years now, and it's helped to assist a lot of our students.

Thank you, Senator.

Senator DOMENICI. Let me say to our three university presidents, I never cease to be amazed at how much we learn. I want to commend all three of you for the points you have made.

Frankly, I am convinced that the United States is in far more serious science and technological danger and competitive danger now than we were post-Sputnik. I mean, post-Sputnik was an event that scared the liver out of us with reference to Soviet military potential.

But what's happened now is a process of attrition. Very slowly our competitive edge is falling off the table because of the scientific prowess of other countries and their manufacturing excellence in applying knowledge and science to the marketplace.

In our kind of system, it's much easier to produce a well-rounded and targeted post-Sputnik program than it is to produce one as a result of gradual attrition.

Having said that, I would say to you, if everything works out, one of your suggestions will take place this year. I refer specifically to student financial aid through the PELL grant program. If we fund this program at the President's request, PELL grants should go up somewhere between $200 and $300 on average per grantee.

With reference to student aid, I know of no initiative around, that are going to change the ground rules for aid and alter the loan package. Student financial assistance is not going down. We might find some ways to let it go up slightly, but it will not be reduced. We have been confronted with suggestions that it be reduced in the past, but that is not the case this year. We are grateful at least for that.

I would like to ask Dr. Lattman, how much meat have you put on the skeleton concept of Engineering Extension Centers?

Dr. LATTMAN. Senator Domenici, and Mr. Chairman, it's all on paper, sir. I'm going to bring it up at the next meeting of the TechNet board of directors, because they could be the data base gatherer of this pool of expertise.

I have been working on it alone for about 2 months. I have a document which I can send you, about six pages.

Chairman CHILES. We would like you to share that with us. In fact, it will be an appendix of this record.[1]

Dr. LATTMAN. I will deliver the document to whomever.

Senator DOMENICI. We have Budget Committee staff members here. They will take it.

Dr. LATTMAN. I don't have it with me, but I will mail it where directed. That means I will have to correct the English, too, but I will get it to you.

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[1] See p. 36.

I believe, in all sincerity, without taking a lot of time, Senators, that until this gap is closed, the small entrepreneur is going to be at an almost insurmountable disadvantage in competition.

Senator DOMENICI. My last question has to do with, again, the four universities and doctorate program universities.

How much trouble are we having maintaining the very best of faculty in the engineering science and math departments of our universities? The doctorates that come for a while and then leave, those that are superbly qualified, are we having trouble keeping them, either young or old experienced?

Dr. HALLIGAN. I would say, for my university, Senator, it's more critical now than at any time that I have been in New Mexico. We have more people interviewing than we ever have had in the past.

Dr. MAY. And competition is increasing across the country.

That's something that we have to recognize, that when we go for the best faculty, we are in national competition.

Those best universities across the country continue to vie for the very best minds, and if we are not successful in getting the cream of the crop in the universities, we really have lost the game.

Senator DOMENICI. Let me comment on the proposition you opened with, that is that you are primarily and principally an educational institution.

I was surprised to have the head of the chemistry department at MIT—which most of us look at and say they're great in transferring technology and in helping business—say unequivocally to me, "Don't forget, our primary mission is to educate young people, produce advanced degrees, and remain on the cutting edge of knowledge."

He also said, "Of course, we're being asked to do other things, but educating young people is our primary mission. Don't overload us."

Nonetheless, they are extremely good at technical transfer and spinning off companies, and so forth.

I want to ask this question:

Would it help, in your opinion, with reference to retention for some period of time of qualified doctorate professors, if we modified the student loan program? I have two dramatic modifications in mind:

One, to make sure we provide sufficient aid as they went through their doctorate program, and two, started a system of automatic elimination of portions of the debt based upon service in an academic community at an accredited university in for instance the science, engineering, math department.

Dr. HALLIGAN. I would just respond, Senator, I think the crisis in mathematics is as great as in any discipline in the United States, particularly due to the fact that many of the students that are participating in those programs are non-native born. I think the United States will be in dire straits in the future because of its lack of graduates in mathematics.

So, such a program would have my enthusiastic support.

Chairman CHILES. Senator Bingaman.

Excuse me. Go ahead.

Dr. LATTMAN. I agree, of course, with Dr. Halligan. I think every inducement possible to retain the best faculty is necessary.

At the next meeting of the board of regents in 2 weeks, in fact, I am going to recommend to them that all children of full time Tech employees go tuition free.

We will have to pay the tuition, since we can't waive it by State law, but any employee of tech will have their dependent children go tuition free. This is one of the ways we have of holding many people, particularly professional people.

I think these types of inducements are going to have to be enhanced.

I would emphasize one other thing. In the last 2 years we have interviewed perhaps 10 people for assistant professorship entry positions in computer science, and brought them to campus and interviewed them and selected three. Of the 10 people, one was a native-born American.

Senator BINGAMAN. Let me just ask two questions.

Very briefly, when I was talking to the Governor, questioning him, he cited this deficit that exists in salary between our universities and comparable universities. He said it was between 9 and 14 percent.

Is that an accurate figure as you folks understand it?

Dr. MAY. Yes, that's not a bad figure. On the average, about 9 percent.

Senator BINGAMAN. OK. My sense is, from the study I have done of it and from what I have read, that the single most important thing we can do to help our universities in this State, and to help the State in all these areas that we're talking about at this hearing, is to close that gap.

If we had to pick out one thing that could be done, it seems to me, from what I have read and heard, that that's the most important thing.

Is that wrong? Is there something else that's more important?

Dr. MAY. Absolutely, our highest priority. We are a people institution and the quality of our institutions depends on the quality of our faculty.

So, each of our institutions assign that the very highest priority, that we get at least to the median of our peers, so that we're competitive.

Senator BINGAMAN. Let me ask, also, on these Centers of Technical Excellence.

I have been as supportive as possible, from the position I have held, with those centers, but I am frankly nonplussed with the idea that the State would support those centers for 5 years and then those centers would be freestanding.

I am on the Armed Services Committee, and it would be somewhat like us saying, we're going to continue to fund the defense logistics agency for another few years but they've got to become self-supporting within 3 years or else we'll cut them off.

It seems to me that the funding of basic research, the maintaining of excellence in basic research in the universities, is something that has to be, at least in major part, funded by government, and I don't really understand the concept of these institutions, these centers, becoming freestanding or standing alone, or becoming able to sustain themselves without that public support.

Perhaps one of you can comment and explain that.

Dr. MAY. Senator, you're absolutely right.

I will point out that that was really the first investment of the State in research, because in the past, the State has always taken the attitude in its formula that it only funds instruction, and that research is basically funded through Federal funds, through NSF, DOE, and so on.

Five years ago, when the State invested in these Centers of Technical Excellence, it was a very good step, it was the right step to do, and each of us created those. But it was the first time that was done. They have multiplied the amount of State money that they're given by a factor of two or three, among the five of us.

Those, we would argue exactly the same way, that in the long run the State should have some kind of responsibility built into our formula, some kind of component for steady support of research in the future.

Senator BINGAMAN. Do the rest of you have any comments on it?

Dr. HALLIGAN. We look upon our Centers of Technical Excellence as a significant asset of the university, and their continued funding as one of our major challenges.

Senator BINGAMAN. That's very diplomatically put.

Dr. LATTMAN. I think, to some extent, Senator Bingaman, it may be a political problem, because, for example, of the six universities, only three have Centers of Technical Excellence, and if they are funded on an ongoing basis, there could be complaints from other schools that they have been cut out of the system.

Certainly, I agree with my colleagues. I would like to see continued funding of these centers.

The concept of funding research, as against purely instruction on the mathematically calculated formula, is a concept which, if accepted by the State legislature, would move New Mexico, particularly graduate education, forward a quantum leap.

There's no State support for graduate education; that's Federal support. If that's where our future growth is going to be, then the Centers for Technical Excellence will be a part, because they use graduate students, on the whole concept of State support for graduate students and research.

Senator BINGAMAN. Thank you, very much.

Chairman CHILES. Thank you. I want to also comment on the excellence of the panel here. Your ideas are all tremendously interesting to me, and to all of us.

Dr. Halligan, I note your call for increased student funding. Overall, if there's any area in Federal Government that we have paid attention to and put money for, it is this. If you want to look back at the time we started that program, it's had tremendous growth in the last 5 years.

Basically, we're looking at 10 to 15 percent annual increases. We are going to make some increases again this year.

I just have to caution that I think sometimes universities get where they count so much on those funds, any time there is just a slowdown of that 10 to 15 percent, I hear such cries of anguish from my people, my people act like we have starved them.

If there's any area where the Federal spigot has been opened, basically, it's been in this area. I say that given the role that we have

of the deficit. Yet, I think it's good, and we are going to do some more.

In that, I would like to have your views as to whether we should be looking at aid, or whether we should be looking at scholarship loans, and, again, what that should be.

Dr. HALLIGAN. Senator Chiles and members of the panel.

I was blessed with the G.I. bill. I would never have been able to go through the university without the G.I. bill.

Chairman CHILES. I am a recipient of that, also.

Dr. HALLIGAN. If you look at the demographics in New Mexico and the income in New Mexico cited by Mr. Vigil, I, for one, favor direct aid to the students and not loans.

There's also a certain cultural bias in New Mexico, I am told, against loans. I happen to think that's wise. But I think that is an appropriate investment on the part of the nation to give aid to students.

Chairman CHILES. But when we're talking about rationed dollars, the idea of the loans being in a revolving fund, and the idea that when you have this increased education you therefore have this ability to have a livelihood that is manyfold more, where are we going to get the most for our dollar?

If we could recirculate this money in a revolving fund, we could maximize our investments. Yes—again, when you got that G.I. bill, and when I received that, that wasn't enough for me to make my way through school. It helped me, with the job that I had, to make my way through school.

And the dollars, indeed, even if you could adjust those dollars for inflation it was still not everything that you needed, especially for any students I knew. You had to do something else in addition to having that.

You don't need to comment on that.

Senator DOMENICI. Mr. Chairman, might I follow-up?

I think there's a big myth out there, and I'm glad the Chairman corrected it.

Frankly, let's just be honest. Because the President submits a budget saying we're going to cut student aid, we still have people standing up saying, "When are you going to reinstate student aid?"

The administration's proposed cuts have gone up substantially every year, both on the loan side, and on Pell grants. However, student aid in real terms, has remained rather constant 2 or 3 years, and it's time to add $200 or $300 to the average Pell grant just to keep pace.

[Whereupon, the committee adjourned subject to the call of the Chair.]

A Proposed "Engineering Extension Service" for New Mexico

L. H. Lattman, President

New Mexico Institute of Mining and Technology

Introduction

It is universally agreed that economic development in the state is badly needed. Much of this development will, of course, be based upon manufacturing. A strong point has been made of the ability of the national laboratories and universities to transfer technology resulting from their own research to the commercial area. Many such transfers are "high technology", involving new products although some of it is, undoubtedly, modification of existing products.

The emphasis to date has been very much on "technology transfer", which usually involves transferring information about a particular item that may be salable. Very little effort has been expended on development beyond the basic research stage and, particularly, little effort has been put on commercial production techniques. It is a very difficult task for a company to take a "high technology" product and immediately move to manufacture. There is a required and sometimes protracted period of product development and determining manufacturing procedure. It is interesting to note in this connection that through the Technological Innovation Programs (TIPS) help is given to companies in dealing with business problems. Thus, they receive support in the development of business plans but very little, if any, support is offered anywhere within the state concerning the solution of product development and manufacturing problems.

Problems

1. Most large corporations have expert in-house engineering staffs. These staffs are usually adequate to handle product development and manufacturing setup. An adequate staff to accomplish this is fairly expensive and should be experienced. Start-up and small (3- to 10-person) companies rarely have the engineering staffs capable of accomplishing the transition from receipt of a new idea to actual commercial production. The Japanese national laboratories deliver their ideas directly to major corporations where the product development and manufacturing studies are carried out. There is no attempt by the Japanese, to my knowledge or those of my Japanese colleagues, to develop small start-up companies without a great deal of support directly from the Japanese government.

2. It is sometimes difficult for small companies to estimate the amount of time that will be necessary to move from initiation of effort to actual production. A common cause of failure of such companies is the impatience of venture capital to see production started. I know from my own experience of several failures of small companies caused within a year after they began operations because no actual production had occurred and those supplying the venture capital concluded it was a bad investment. Thus, a considerable contributor to failure of small or start-up companies is underestimation of costs of product development, poor or inadequate product development and, finally, manufacturing costs that are too high. It must be remembered that in solving the manufacturing problems the company must end up with a product which is competitive on the national and international market.

3. Many start-up or small companies have no idea as to what expertise is available to help them in product development and manufacturing or how to find such expertise in general.

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4. It is difficult also for small companies who have already achieved production to stay up with the latest product and manufacturing developments. Again, an expensive technical staff is needed to keep the companies competitive over a period of time. Many small companies which begin well fall by the wayside because of the inability to stay current in all technical developments.

5. Frequently, operating personnel being used by small or start-up companies are inadequately trained for the very specific and detailed tasks they will be encountering and such training is commonly too late. It is clear that regardless of the general background of the operating person they must be trained for specific tasks and sometimes in an anticipatory manner.

While not all of these problems can be easily addressed, there is something that can be done to provide much help.

Consideration of Solutions

1. Any help must be easily and readily accessible to small and start-up companies or, for that matter, also large companies which may seek to obtain it.

2. Such help, particularly, for the start-up and small companies, must be generally inexpensive. They cannot compete with major corporations in massive engineering efforts.

3. Whatever solutions are advanced by the state or federal government must not compete directly with private consultants, but rather cooperate with them to the betterment of the entire effort.

One solution which would go, I believe, a long way toward addressing the problems discussed above is an Engineering Extension Service somewhat analogous to, but not directly parallel to, the well-known and widely available Agricultural Extension Service.

Engineering Extension Service

I believe that in the beginning the Engineering Extension Service should be based in the university community. The reasons will emerge below. It should not be the effort of a single university but should involve all universities with an engineering and/or science faculty. In New Mexico, the primary effort would be based in the so-called "research" universities. The major reason for basing the Engineering Extension Service in universities is that the initial group of experts would be drawn from university faculties, although, it would be later much enlarged.

The Engineering Extension Service would be a first point of approach by an entrepreneur interested in commercializing an idea of his own mind or one he or she has received from the national laboratories or other sources. The Engineering Extension Service would function primarily as a referral office to enable the entrepreneur to get in touch with people who can help him or her directly in product development, product testing, product evaluation, and manufacturing procedure.

To do this, the Engineering Extension Service would develop and maintain a data base of engineering and science faculty, especially those with industrial experience, who can be of help. Thus, it would be possible for any entrepreneur

who is intersted to approach the Engineering Extension Service and be put directly in touch with someone who has knowledge or experience in the engineering aspects of their effort. Some of the requirements of this data base will be discussed below.

In addition, of course, to knowing the expertise within the various universities from firsthand knowledge and from the data base, the Engineering Extension Service personnel themselves should be able to talk with the entrepreneur and outline the general problems he faces and give general advice.

One of the great advantages that New Mexico has already is the existence of Technet. Engineering data bases of expert faculty and other personnel could be maintained separately at the various schools, kept thoroughly up to date, and be instantly accessed through Technet. There is no reason that, after the Engineering Extension Service is set up, additional personnel could not be drawn from retired manufacturing experts, persons from the national laboratories who wish to help or, for that matter, private consultants. Eventually, such a data base might well contain in it the entire range of expertise reasonably available to help enterpreneurs solve technological problems within the state of New Mexico. It is not impossible that data bases of several states could be linked together so that, in fact, expertise over a broader area than a single state would eventually be accessible. A national network is a desirable end.

In addition to preliminary discussions and to serving as a referral service to experts elsewhere within the state, personnel of the Engineering Extension Service should put out update notices and conduct follow-up visits to keep those companies which are receiving help from them completely in the forefront of technology. A rather simple set of update notices sent to those companies which would likely profit from it would not be a very onerous task. Direct

follow-up visits might bring to the attention of the entrepreneurs certain new problems or problems for the immediate future that could be anticipated and perhaps solved by expert engineering advice.

Organization of Engineering Extension Service

Because initially the Engineering Extension Service will draw heavily upon faculty expertise in manufacturing and product development, I believe it is better that the service be based in universities rather than be a state agency within government. A board of directors could be responsible for the Engineering Extension Service and it could consist of, for example, three engineering administrators from the research universities, two business people in the field of manufacturing, and two state persons, including at least one from the Department of Economic Development and Tourism.

I believe, for start up purposes, that the Engineering Extension Service should have three professionals, all with manufacturing expertise or experience. The actual fields of such expertise are not important. These personnel would consist of a director and two field persons who would maintain contact with the start-up companies and be able to respond on call for quick plant visits to determine the general nature of problems being encountered. One additional professional person would be needed to set up and maintain the data base of expert persons and a suitable non-professional staff would also have to be provided for office work.

Initially, funding should be for a minimum of three years. Presumably, this funding would come from the state and/or federal government as start-up money. Once the Engineering Extension Service is in operation there could be minimal charges for its use, certainly to help maintain it. In addition, it is not unreasonable to expect charges to be paid for professional consultants

who wish listing in the data base. Those faculty would want to treat this entirely as a private consulting matter upon referral from the Engineering Extension Service also would be expected to pay a reasonable fee to be listed. Those faculty who would help as a public service or just for expenses could, of course, be listed in the data base free. Additional funding for the engineering extension service might come from equity positions in the companies which are being helped.

Data Base

It is obviously extremely important that the data base be kept up to date and as complete as possible. It should certainly not be a medium of advertisement for engineering consultants but must list in some detail and quite accurately the precise experience the individual person has that can be of direct help in product development and manufacturing for specific products. Considerable thought would have to go into the various subheadings and classes within the data base to make certain that it is possible to obtain the best consultation to solve particular problems. In this respect, education might be of secondary importance to experience, although, both are obviously important. I would suggest that help be obtained from existing large corporations and experienced engineers in setting up precisely the parameters of the data base so that it has maximum utility.

Conclusion

In conclusion, I believe that the weakest link in the chain from technology transfer to commercial production with resulting job opportunities and economic growth, is the inability of start-up or small companies which do not have adequate and expensive engineering staffs to deal realistically with the problems

of product development, manufacturing, quality control, and real cost analysis. Many such efforts have been unrealistic as shown by the failure of many companies in the past. Even though expert business plans are drawn up, the lack of experience in technological problems and in estimating manufacturing costs frequently results in severe underestimation of time and money needed to achieve commerical production. While the Engineering Extension Service concept certainly will not solve all problems, I believe it will contribute very significantly to economic development in the state of New Mexico, particularly, in the area of manufacturing and most especially in manufacturing based on frontier technology.

Finally, one must not forget that after manufacturing has started, problems arise from the company slipping behind the state-of-the-art technology or being out of touch with some of the latest advances in manufacturing. Generally, the inability of a small company to maintain itself up to the minute in technical change is a problem of some importance. Here, again, the Engineering Extension Service could provide a valuable link in the maintenance of a company's technical health.

STATEMENT OF DR. JAMES F. DECKER

ACTING DIRECTOR OF ENERGY RESEARCH

U.S. DEPARTMENT OF ENERGY

before the

SENATE COMMITTEE ON THE BUDGET

March 9, 1988

Santa Fe, New Mexico

Mr. Chairman and members of the Committee, I am pleased to appear before you today to discuss the activities of the Department of Energy (DOE) and its National laboratories and their importance to U.S. preeminence in science and technology and overall economic productivity.

I will discuss in general terms the importance of Federal R&D and the extensive science and engineering capabilities of the National laboratories in developing both science transfer and technology transfer that contribute to the Nation's overall competitiveness, and to the local and regional economies of their respective areas. In carrying out National missions and programs, in research and development, technology transfer and science education, the laboratories also contribute to the well-being and competitive position of the private sector in their States or regions.

Through its technology transfer policies, the Department also encourages the establishment of spinoff companies consisting of a few scientists with a patent waiver and lots of enthusiasm for developing a company around a technical concept or invention. While it is difficult to know the precise numbers, many of these spinoff companies locate in the immediate area, as long as it has an environment conducive to exploiting the technology. The laboratories, therefore, not only can and do have a Nationwide impact in carrying out their programs, but also represent positive advantages to the local private sector.

The Department of Energy, and its National laboratories have a long history of transferring technology and supporting the education of research scientists and engineers. Nuclear power, nuclear medicine, radiation

processing, and ion implantation are a few of the widely known examples of the technology applications derived from the Department's mission research over the past 40 years. The consistent support in providing students and faculty with hands-on research experience at its major R&D facilities is equally impressive. The laboratories of the Department of Energy have a broad range of technology transfer activities and science education accomplishments that are resulting in exciting new business opportunities for U. S. industry and better prepared new scientists and engineers to take on the challenges of research and development.

Technology Transfer

Mr. Chairman, I would like to call your attention to the gray and black document that is on the table in front of you. Its title is Technology '87. It has just been completed and copies have recently been distributed. The report contains descriptions of accomplishments in technology transfer from the Department of Energy (DOE) and its laboratories. We brag--justifiably, I think--about our successes in transferring the benefits of research achievements to others for future advancement and development. We talk about what we've accomplished in our leading edge research in basic science, applied energy research and engineering development and biology and medicine.

Recent examples that are meeting the test of the marketplace are:

- Compact helium dilution refrigerator from ANL
- Advanced teleoperated robot for working safely in hazardous environments from ORNL
- Biobarrier process that uses herbicides in gaskets between two pieces of pipe to prevent root growth into sewer lines from PNL.

Technology '87 is an example of DOE's commitment to ensuring that the maximum benefit of Federal R&D is realized by private industry, universities, and State and local governments. I invite you to read through this document. I am sure that you'll agree that the DOE national laboratories are an important national resource and that they contribute significantly to overall U.S. economic competitiveness.

DOE is committed to improving the industrial competitiveness of the U.S. and to supporting the scientific excellence of our Nation's universities. Technology transfer from DOE laboratories continues to build on past successes and to expand into a major factor in transferring scientific results into the U.S. economy through an aggressive program. The Department's technology transfer efforts include a range of activities such as personnel exchanges with industry, industrial use of large scientific facilities, licensing of patented inventions, formation of new companies by

laboratory personnel, consulting by laboratory staff for industry, etc. All of these activities can and have led to new products.

Perhaps the greatest contributions have been the broad scientific and technological developments that have resulted in whole new industries. The nuclear power industry and the role of the Atomic Energy Commission need no further elaboration. Fewer people are aware that a large percentage of the research in nuclear medicine has been funded by the Department and its predecessor agencies starting with the AEC. As a result, the use of radioisotopes in medical examinations has provided major advances in diagnosing diseased organs. Each year, there are over seven million nuclear examinations in this country alone. These developments have also created a substantial industry that supplies radioisotopes and nuclear medical equipment.

Supercomputer technology is another example where the Department has made enormous contributions. The DOE laboratories at Los Alamos and Livermore pioneered computational science; worked with computer vendors to design more powerful machines; provided most of the market for supercomputers in the 1950's and 1960's, and spent considerable resources developing applications codes and systems software. Some other agencies, such as NASA, have also made contributions to supercomputer technology in recent years, but DOE is generally credited with playing the largest role.

At the other end of the spectrum are the more recent technology transfer activities that are necessarily viewed as individual events that will hopefully lead to new products. For example, last year, over 3,000 users from industry performed experiments at DOE scientific facilities. Over $118 million in research and development was performed by our laboratories directly for industry. In addition to that effort, the national laboratories participated in 57 collaborative projects with industry representing over $11 million worth of research and development. In 1986 alone, 31 new companies were formed based on the laboratory-developed technology. An additional 162 technologies were transferred from DOE laboratories to existing firms. Thirty of the 1987 IR 100 Awards, presented annually by Research and Development magazine for the 100 most significant new technical products in the world, were awarded to inventors in DOE laboratories. Two of the 1987 awards were to scientists at Sandia. In fact, one of these scientists has left the Laboratory and has established his own company, TECHNOR, Inc., based on his invention which removes more than 99 percent of the nitrogen oxides from exhaust gases.

In FY 1989, the R&D Laboratory Technology Transfer activity will provide joint support to 30 industry scientists and engineers to work on research assignments at national laboratories side-by-side with DOE's scientists, with the objective of transferring federally supported expertise

to the private sector for commercial application. These assignments are cost shared with industry and involve both large and small companies. In FY 1988, through this program at LANL, Cummins Engine Company is working to gain a better understanding of its KIVAS computer program and the application to internal combustion engines. At Sandia National Laboratory in FY 1988, Lennox Industries, Fisher-Barton, Inc., and CIM Corp. all have industrial exchange personnel on-site at the Laboratory. Support will also be provided for pilot laboratory initiatives to improve spinoff of federally funded R&D to U.S. industry.

Los Alamos and Sandia both participate in the Rio Grande Research Corridor Project which strives to direct New Mexico's technological resources toward economic growth and diversification. The use of these Federal laboratories as a resource in New Mexico by both new and existing businesses will continue to be encouraged. The number of new spinoff companies formed based on DOE developed technology is increasing steadily. Since 1985, some 10 new companies have been based on new technology from Sandia and another 10 companies were formed from Los Alamos technology.

Significant progress has been made to provide DOE's nonprofit contractors with the right to elect to retain patent rights in all areas, except defense and other sensitive programs. To date, contracts for 11 such laboratories, including Los Alamos have been modified.

One can also look at individual products that are the direct result of research and development in DOE laboratories. A few examples with relatively large impacts are:

- Laminar Flow Clean Room--Developed at Sandia National Laboratories, this technology is used extensively in hospitals and semiconductor manufacturing facilities.

- Zonal Liquid Centrifuge--This technology, developed at Oak Ridge National Laboratory, made possible ultrapure flu vaccines and is the principal equipment used in preparing today's vaccines.

- Numerically Controlled Diamond Turning Machine--Lawrence Livermore National Laboratory, a leader in precision engineering, greatly advanced the use of diamond cutting tools with the development of this technology. It is used in the manufacture of such diverse products as molds for plastic lenses to videotape recorders.

- Gamma-Ray Imaging Camera--This device, developed by Lawrence Berkeley Laboratory, detects the distribution of radioisotope tracers introduced into the body and is used in hospitals and clinics throughout the world in disease diagnosis.

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- Flow Cytometry--Developed at the Los Alamos National Laboratory, the flow cytometer characterizes and sorts individual cells, permitting the measurement of cellular properties and changes in those properties on an individual rather than on a population-average basis. Four companies currently offer flow cytometry systems.

- Purified Rare Earths--The technology used to separate and purify individual rare earths was developped at the Ames Laboratory and ORNL in the 1950's. Ames today remains the principal National center of rare earth chemistry and technology competence. In 1985, over 500 tons of purified (+99.99 percent) rare earths were prepared by industry based on the DOE laboratory-developed methods. Rare earths play important roles in TV, lighting, and medical imaging phosphors; lasers; high-strength magnets; magnetostrictive energy converters; targets for medical radioisotope productions; advanced electronic semiconductor devices; and others. Market value of products whose performance depends on rare earth products is known to exceed hundreds of millions of dollars per year.

- Polycrystalline Diamond Compact Drill Bit--Sandia scientists developed a technique for bonding synthetic diamonds to drill bits that greatly improves the performance and reduces the cost of drilling through hard rock. This technology is widely used in the oil and gas drilling industries and results in savings of tens of millions of dollars per year.

The Department is moving rapidly to couple its research programs with those of U.S. industry and other researchers. In response to the President's Superconductivity Initiative, Secretary Herrington has established three centers to conduct research on superconductivity and to act as sources of information. These three centers are at Argonne National Laboratory, Lawrence Berkeley Laboratory, and Ames Laboratory.

In addition to these research centers, a computer-based data base has been established to provide day-to-day information on superconductivity to U.S. industry from one focal point--DOE's Office of Scientific and Technical Information in Oak Ridge.

Also, two consortia of laboratories have been organized to conduct research aimed at particular aspects of materials processing: Los Alamos, Oak Ridge, and Lawrence Berkeley on synthesis, thin films, and alternate processing materials; Argonne, Brookhaven, and Ames on conductor development.

In a closely related initiative, the Los Alamos National Laboratory is leading an effort to examine possible technology transfer mechanisms, including cooperative ventures among DOE laboratories, U.S. industry, and universities. A proposal from the Laboratory is currently under consideration at Headquarters.

In the Department's human genome research, the Secretary has directed Los Alamos National Laboratory and Lawrence Berkeley Laboratory to establish centers to study the human genome. These centers are both developing the new technology required for the project and carrying out research on physical mapping of the human genome. Work at these centers will be done in cooperation with efforts at universities, the private sector, Lawrence Livermore National Laboratory, Pacific Northwest Laboratory, and other DOE laboratories. These explorations could lead to a pilot program which could be a model for other DOE laboratories.

One area that often gets overlooked in evaluating technology transfer is the significant benefit to industry in a region resulting from the construction and operation of any large research facility. CERN (the European Organization for Nuclear Research) issued a study a few years ago on the "Economic Utility Resulting from CERN Contracts." The study quantified some of the economic benefits to high technology manufacturing industries involved in CERN contracts. While no hard data is available in

the U.S., there is rising concern on the part of some of the Department's laboratories of the apparent lack of interest from U.S. companies in bidding on research projects. Foreign interest in such projects in the U.S., on the other hand, is very high.

Science Education

Congress is well aware that the continuing health and vitality of our Nation's scientific and technological enterprise are closely tied to that of our scientific and technical education system. The Department and its national laboratories are significant consumers of the Nation's scientific and technical talent. Therefore, the Department has a major stake in the vitality of our scientific and technical education system. We, along with all scientific and technical organizations, whether public or private, must assist in the national effort to strengthen our science education system.

Concerns about the viability of our science education system arise from the following facts:

- There will be 25 percent fewer college age young people available for the national manpower pool beginning in the mid 1990's compared to the mid 1970's.
- College freshmen interest in pursuing science and engineering degrees peaked in 1984 and is now declining.

- U.S. citizens earn 67 percent of all PhD's in science and engineering awarded by U.S. universities. But foreign students on temporary visas earn more PhD's in engineering than U.S. citizens.

- Over two-thirds of the science and mathematics teachers in U.S. secondary schools do not have college backgrounds in the subjects they teach.

- U.S. 18 year olds were last in mathematics competition compared with 18 year olds from six other foreign countries in 1987.

With this as context, what can the Department of Energy do to help meet the challenges of maintaining U.S. preeminence in science and technology? The Department's efforts and plans are firmly based on what is unique about DOE as compared to the National Science Foundation and the Department of Education, the agencies principally responsible for supporting science education. The Department's unique resource is our extensive network of world-class research laboratories and facilities staffed with thousands of creative scientists and engineers pursuing research in almost every scientific and technical discipline.

Under Secretary Herrington's leadership, we have significantly expanded the involvement of our laboratories in both precollege and university-level programs. For example, over 5,000 university graduate students, 1,000 undergraduate students, 500 high school science students and 100 high school

science teachers spend a portion of each year either conducting research or pursuing scientific educational opportunities at our national laboratories and research facilities. Providing opportunities for students, teachers and faculty members to experience first-hand the excitement and challenges of scientific research is what we can do best. Let me cite several examples of the opportunities we propose to continue in FY 1989.

Secretary Herrington personally inspired our first new initiative, the DOE National High School Honors Research Program. Each year, the Governor of each State selects the Nation's very best high school science students to participate in "hands-on" research and instructional programs at several DOE laboratories. In FY 1989, we plan to sponsor seven Honors Research Programs in the following research areas:

- Particle physics (Fermilab)
- Life sciences (Berkeley)
- Synchrotron radiation research (Brookhaven)
- Environmental research (Oak Ridge)
- Superconductivity (Argonne)
- Computational science and supercomputers (Livermore)
- Marine and earth sciences (Pacific Northwest)

Through 1989, over 1,040 of America's very best and brightest young men and women will have participated in laboratory-based Honors Programs a significant fraction of the next generation of our Nation's scientific and technical leaders.

The Secretary undertook a second major DOE science education initiative in FY 1987 by establishing comprehensive Science Centers at five multi-program DOE laboratories. These Centers provide a year-round focus for student and faculty research and education activities utilizing the unique physical and human resources at each of the participating laboratories (Argonne, Oak Ridge, Brookhaven, Lawrence Berkeley, and Pacific Northwest). Additional Centers will be established in FY 1989 at Los Alamos National Laboratories. One key activity sponsored by these Centers is an academic semester research program for undergraduate science and engineering students selected nationally based on academic merit and future research potential. Approximately 450 undergraduate students will participate in this semester program in FY 1989. This is in addition to the approximately 1,000 undergraduate students who participate in research activities during the summer at the DOE laboratories.

Finally, in recognition of the essential roles of high school science teachers in helping to prepare our next generation of scientists and engineers, our FY 1989 budget request includes a new initiative designed to bring at least 200 science teachers each year to the DOE laboratories for summer research and instructional experiences. These teachers will be selected both on a national and regional/local basis and will be provided opportunities to participate in laboratory research. Based on this research, they can be expected to develop educational materials to be used in their classrooms.

Both Los Alamos National Laboratory (LANL) and Sandia National Laboratories have extensive interactions with scientists from universities across the country. Over 1,000 faculty from over 300 colleges and universities participate in research at LANL. A significant portion use LANL's scientific user facilities such as the Los Alamos Meson Physics Facility (LAMPF). Sandia supports a high number of faculty and graduate students on summer research appointments each year. And both LANL and Sandia have been involved with undergraduate cooperative education programs with the New Mexico schools in their areas for decades. In addition, LANL, Sandia and the Oak Ridge National Laboratories are participating in a unique collaborative effort with three historically minority institutions: New Mexico Highlands University (predominantly Hispanic), North Carolina A&T State University (predominantly Black), and the Ana G. Mendez Education Foundation (Puerto Rican). The effort includes scientific and technical assistance, equipment loans, computer time, joint research, summer internships for faculty and students, etc.

We recognize that our science education activities are only ripples in the National pond that awards over 300,000 BS degrees, over 60,000 MS degrees and over 18,000 PhD degrees in science and engineering each year. But these activities are nevertheless important in that they serve as models for what can be done by other Federal and industrial research organizations to meet both the demographic challenge and the quality challenge that face us in science education. I believe a key approach is to involve actively our own scientists and engineers in helping to prepare and develop their own future replacements.

In summary, the Department of Energy is committed to the success of its science education and technology transfer activities. We plan to continue to be innovative in developing new ideas to further take advantage of the unique capabilities of the Department's national laboratories in enhancing not only the Nation's overall competitiveness, but the local and regional economies of their respective areas as well.

That concludes my prepared statement. I would be happy to answer any questions you may have.

SENATE BUDGET COMMITTEE HEARINGS
ON STATE AND LOCAL ECONOMIC DEVELOPMENT
SIEGFRIED S. HECKER
DIRECTOR
LOS ALAMOS NATIONAL LABORATORY
March 9, 1988

I appreciate the opportunity to speak on a subject of great interest - economic development.

I will restrict my comments today to how the national laboratories can help in economic development.

There are three principal ways in which we can help:

1. By being strong and healthy labs we contribute to the state,
2. We encourage entrepreneurship - for the creation of new businesses based on Laboratory technologies,
3. We can enhance our impact on economic development by forging new partnerships with industry.

1. Strong and healthy laboratory - premier research and development institutions.

- Los Alamos is a major employer in New Mexico
- It is also one of the major consumers of goods and services; we want to keep it this way
- The Laboratory's principal reason for existence is to do research and development technologies critical to the federal government
- This includes:
  1) nuclear weapons technology to maintain this nation's deterrent which has been the cornerstone of our national security
  2) nonnuclear weapons technologies for SDI and advanced conventional concepts

3) nondefense technologies and basic research including energy, health, and environment

- For the Laboratory to remain a major employer, we must perform well in our primary missions for the federal government
- The Laboratory has a budget of $887M operating and $100M in capital and construction - close to $1B total:
  - We employ ~8000 FTEs (9000 people) plus 2000 support contractors
  - The economic impact on New Mexico is enormous - close to three times our budget - or $3B
  - This represents 38% of the jobs in the tri-county area
  - Even on a statewide basis the impact is significant - one out of every $20 in New Mexico can be traced back to the Lab; similarly, one out of every 20 jobs
- Beyond the specific dollar impacts, there are other benefits
  - The Lab requires lots of goods and services - procurements add up to $470M/year
  - $270M is spent in New Mexico. This has helped to build the infrastructure and support the economic base required for high-tech development
  - The Lab has had a very positive effect on the quality of education in the state
  - We have an extensive precollege outreach program designed to encourage students to pursue their education, particularly in areas of science and engineering
  - For example - last year we reached over 20,000 students and teachers in grades 4 through 12
  - We employ ~560 graduates of New Mexico universities at the Lab today

To conclude this point - as long as we remain a strong institution dedicated to excellence, in service of this country, we will contribute to the economic development of the state.

2. My second point is that we encourage entrepreneurial spinoffs.

- The startup of new businesses by Laboratory employees based on ideas or technologies developed at the Laboratory enhances the economics of the local region and the state
- Such spinoffs have been encouraged by the federal government (both legislative and executive branches) through new legislation
- At Los Alamos we encourage our staff to develop their ideas with commercial potential. We offer entrepreneurial leave for employees who wish to test the waters of commercialization
- During the 1980s, 29 private coompanies have been spun off from the Laboratory. Of these, 23 are still in the greater Los Alamos area
- Let me just cite one example - Amtech Corporation
  - It was founded by several members of Laboratory staff in 1984
  - They received a patent waiver for a passive electronic detection device developed at the Laboratory with U.S. Department of Agriculture funding for livestock identification
  - These ideas have been upgraded substantially and are now used for cargo shipment identification internationally
  - The company has grown to employ 45 people
- Such startup ventures can be aided significantly by local small business incubators such as the one at Los Alamos

- The universities and state government can play a very beneficial role by helping the entrepreneur with business advice and know how

3. Let me now turn to my suggestion of developing new partnerships with industry to enhance technology transfer and encourage economic development.
   - New approaches to technology transfer are necessary because the U.S. must improve its competitiveness internationally
   - The current approaches have yielded some success - but have not come close to tapping the enormous potential of the laboratories
   - To date we practice technology transfer by what Roland Schmitt of GE calls the chuckwagon approach
     - The Labs develop a technology and yell "come and get it"
     - This approach does not work well because there is insufficient market input:
       1) The Labs typically promote technology push -
       2) It is imperative to incorporate the market pull of industry to enhance commercial success. In other words, applications must help to drive research and development
   - We at Los Alamos have suggested that the national laboratories do research and exploratory technology development in certain areas of key technologies for U.S. competitiveness in the international marketplace
     - Industry would become an active partner very early in this process to help guide the research and development based on market considerations
     - Industry would also be involved in joint R&D ventures with the laboratories - contributing both staff and funds along with the federal investment

- We envision this Laboratory-industry venture to concentrate on research and development of emerging technologies required for effective commercialization of products

- Our suggestion is in the form of a proposal to DOE to establish such joint Laboratory/industry ventures in the area of high-temperature superconductivity
  - The proposal also suggests a pilot program - let's call it an experiment - to streamline the entire contracting and intellectual property rights process
  - This is critical from industry's standpoint for a successful collaboration between industry and the laboratories
- This proposal is currently being reviewed by the Department. We have received an enthusiastic response from industry for such an endeavor
- I believe that high-temperature superconductors are the perfect test vehicle to explore these new concepts with industry
- If these concepts work, there are several other areas of technology ready for exploitation. These include:
  - advanced materials
  - biotechnology
  - computing and information processing
- I should add that such partnerships with industry are also appropriate by developing technologies for defense applications
  - We are currently teaming with Boeing Aerospace Corporation to develop the RF free electron laser for the WSMR application
  - We are also teaming with Grumman Aerospace and McDonnell-Douglas in the neutral particle beam concept for SDI

In summary - I have mentioned three ways that the laboratories do and can enhance economic development in the state.

- I would like to leave one major recommendation:

  That the state, local and federal sectors work together to identify and select areas of emerging technologies in our labs and universities which target unique market niches for New Mexico.

- We should then concentrate our resources on those few efforts to increase our chances for success against formidable opposition in many states.

I have personally been trying to promote one specific area of emerging technologies - that of advanced materials. This includes:

ceramics

composites

intermetallics

polymers

opto-electronic materials

We are clearly too late for a silicon valley - but may be able to get the jump on a materials valley.

What gives us a competitive advantage?

- The substantial materials R&D programs at Los Alamos and Sandia - augmented by the AF Weapons Lab
- The increasing expertise in materials in our research universities, principally NM Tech and UNM

  Includes two CTEs

  1) High Explosives at NM Tech
  2) High-Tech materials at UNM

- In addition - we are putting final touches on a new initiative by NSF and DOE to establish a Center for micro-engineered ceramics at UNM

Interest in industry in the processing and synthesis is very high.

The combination of defense and civilian applications for advanced materials is enormous - if we act now - New Mexico may carve out an important niche.

I look forward to working with all of the players in NM to develop these ideas.

Thank you for the opportunity to express my views.

SENATE COMMITTEE HEARING

ECONOMIC GROWTH AND DEVELOPMENT

PANEL # 4 INDUSTRY AND LABOR

TERRY HUTCHERSON LABOR REPRESENTATIVE

MARCH-9-1988

I appreciate the opportunity to be addressing you. What we were able to accomplish in Roswell was a united effort of TRANSPORTATION MANUFACTURING CORPORATION and ourselves, the INTERNATIONAL ASSOCIATION of MACHINISTS and AEROSPACE WORKERS, Local Lodge 2577.

We had to have an understanding of the facts and they had to understand our needs and how we operate. To do this, a better communication channel was developed. Several meetings were set up and we were shown the many states competing for the R.T.S. plant. We were also shown the shipping expenses and the distances to the various markets. T.M.C. then asked us for early negotiations for the purpose of setting in concrete what could and could not be done at a later date when we would have normally been in negotiations. Our reply was, wait until we poll the rank and file, as they had to give us their approval. We met with our members and had them fill out questionnaires. The result was overwhelmingly in favor of early negotiations for the purpose of trying to help the company relocate the R.T.S. plant in Roswell.

We began negotiations knowing the company would be asking for cutbacks, also knowing we could not enter into a concession of wages unjustly. When we began we knew it would be hard and take many long hours, sometimes around the clock.

We were told of $1.31 an hour wage cut, and shown how the figures were compiled. Under the direction of Tom Hurd, a Grand Lodge Rep., we devised an entry wage scale which takes 2 years to reach the top. We agreed to a 2 year freeze of our present wage. We allowed the new entry level employees to be without benefits and insurance for 6 months. This was an attractive offer to the company, but what was in it for us.

We had to have gained something or our members wouldn't ratify the new agreement. We were able to obtain a 40¢ an hour increase in the third year of the contract. We were also able to get a much needed overhaul of the seniority provisions, and increases in insurance and pension. There were several areas where we gained, and it looked promising. The members voted and it was accepted!

By the taking and giving of the collective bargaining procedures, we got to a median which was good for both parties and enabled the company to go for the R.T.S. plant. We are in the business for the same reasons, to make money! Thank our members for having the foresight to see the economic possibilities for T.M.C., the community, and ourselves, and the possible results if we didn't accomplish our goal of getting the R.T.S..

We expect the future to be very bright for T.M.C. and the community. We know some of that will be reciprocated to us for aiding in the accomplishment of our goal. I say our goal, as we worked together. Management and labor can work together for the benefit of all. It requires good communication channels, an equal amount of trust, and the ability to understand and appreciate each others points of view.

What we did in Roswell is more along the line of helping an existing industry acquire additional industry.

If I have been told correctly, what you want is to know how to apply what we did to bring in new industry. To that I say, the answer is very similar. Listen to the people, try to understand their points of view, know what you want and work hard to try and get it. Communicate back to them and let them know what you like or don't like, what you can do and what you can't do. You will always be effective, however, most likely due to a budget, or restrictions, or lack of support.

We personally feel that a good sound educational system and a good quality vocational system, having a highly educated and trained community from which a labor force could be built upon, would be a very good incentive for new industry seeking locations. As good as our educational system is, there is room for improvement to be competitive with other states systems. We feel this should be a major concern of all New Mexicans.

In recent years, many people have thought that the Right to Work law would help bring industry to New Mexico. This is not true! We think the Right to Work is actually a very damaging law to economic growth. It adversely affects the states educational system. Right to Work states spend 21% less on education. That equals about $800.00 less per student per year. A higher percentage of students in Right to Work states consistently score in the bottom half of the nation on standardized tests.

The fact is Right to Work laws do not attract business and jobs. Business decision makers told "Business Week", that 19 other issues were more important than Right to Work when making location decisions. Most important, were factors such as access to markets, transportation, educational systems, and a skilled labor force. If we want more jobs, that's where we should place our emphasis and energy, on teamwork to fulfill those needs.

Once again, thank you for having me speak to you on this matter. I hope I have given you information that you can use.

Irwin Welber
President, Sandia National Laboratories

U.S. Senate Budget Committee Hearing

Santa Fe, New Mexico

March 9, 1988

I am delighted to have the opportunity to speak today with the Senate Budget Committee. I am particularly pleased that the hearings are being held here in New Mexico. I think this is particularly appropriate because I want to speak about the role that energy plays on national security and because this state has much to contribute.

Today I want to address the following needs:

1. We need your support for a recovery program for oil and gas.
2. We need your support for our coal R&D program.
3. We need to lay a technical and institutional foundation for a new generation of nuclear power plants that meet the safety, reliability, and environmental concerns.

Energy is important to the Nation.

I think we all recognize the importance of energy to this nation. I want to describe some of the energy issues, such as oil imports, conversion of coal and nuclear energy. New Mexico has

lots to contribute in all of these areas; for example, New Mexico has considerable reserves in oil, gas, coal, and uranium and has two national laboratories that are performing research in each of these areas.

Oil imports have a dramatic effect on our economy.

In 1987 U.S. crude oil production declined to the lowest level in a decade, while imports grew at the fastest rate since 1980; today almost 40 percent of the oil used in the U.S. is imported, further adding to our trade deficit. Most projections indicate that imported oil will account for over 50 percent of our total consumption sometime in the early 1990s, and if usage continues unchecked, imported oil will result in a foreign trade bill of $200 billion by the year 2000. Such a situation threatens the national security of the country not only from a strategic viewpoint, but also from the aspect of economic stability.

Energy is a national security issue.

Let me quote a statement by Llewellyn King..."There is no point whatsoever in spending $300 billion a year on national defense if, as somebody said, you have to rely on a thin line of tankers from Saudi (Arabia) to keep your war machine functioning. It is not a viable defensive posture."

We must not depend on foreign energy sources.

If we as a nation are to maintain a secure economy, we must reduce our dependence on foreign energy sources. We must develop and pursue credible energy supply options over the next decade. Efforts must focus on the replacement of today's liquid fuels with alternatives where that is possible. Although we have a number of options that support this goal, realistic estimates of production levels, environmental effects, and technical constraints indicate that no one source will provide the answer. Solving the energy supply problem requires that we pursue many options.

Coal can be a key to a secure U.S. energy supply.

The U.S. possesses abundant coal reserves, estimated by some to represent a 400 to 500 year supply. Although coal currently provides less than 25% of our energy demands, it accounts for about 75% of our combined fossil fuel reserves. Therefore, to take full advantage of this resource we must develop technologies to burn coal both efficiently and cleanly. We must also develop ways to convert coal to liquid and gas fuels. In this way, coal can offset declining oil and gas supplies, and coal can be a key to the future of a secure U.S. domestic energy supply.

Thus, we need a long-term, science-based R&D effort directed at technology and processes. This R&D effort is missing from the Innovative Clean Coal Technology (CCT) program.

Nuclear energy can provide a large domestic energy supply.

Commercial nuclear energy has grown to generate 18 percent of our nation's electric energy demand, or six percent of our primary energy consumption. It's a substantial contribution, but this six percent has been eclipsed by other industrialized nations. (For example, European Economic community, 11%; including France (29%), Federal Republic of Germany (10%), and Spain (10%); Japan, 11%; and Canada, 7%.)

The nuclear energy contribution to the U.S. energy supply has not fulfilled the expectations of the technical, industrial, and political leaders who were the pioneers and architects of this nation's nuclear energy program. I encourage all of us to support the development of improved nuclear power program that stresses the protection of the environment and safety in all phases.

New Mexico produces the basic material of nuclear power, particularly uranium. Its research laboratories are involved in all phases of nuclear power, extending from contributions to the safety and reliability of nuclear reactors to the handling and disposal of radioactive wastes.

National laboratories provide technology; industry provides energy.

The Federal Government provides vitally needed research in energy. Energy is such a diffuse issue it cannot be addressed by any one industry. However, only industry can apply the technology and supply the energy that this nation needs. Therefore our job as a national laboratory is not only to help with the R&D but to make sure this technology is placed in the hands of American industry so that it can be utilized quickly.

Sandia provides technology to industry.

We have an active program of sharing our technology with U.S. industry. For example, one of the most important techniques we've developed is an improved drill bit designed for drilling through hard rock. We worked with the producer of industrial

diamonds as well as the manufacturers of drill bits to make this improved design. This design was transferred to several drill bit manufacturers and is in active use in the drilling industry. Bits based on our design now account for approximately half of the footage drilled in the U.S.. This new bit saves hundreds of millions of dollars annually in comparison with the previous technology.

In more recent research at our Combustion Research Facility, we are working with the Lennox Company to develop more efficient combustors which will save the hard-earned oil and gas that will become in short supply in the future. Further, we are also learning to burn fuel with fewer pollutants and Sandia technology to this end has resulted in a new company devoted to commercializing the process called RAPRENOx. We appreciate the Congressional support for construction of phase II of the Combustion Research Facility.

We are actively working with a number of companies in transferring our energy technology. These include General Motors, John Deere, Cummins, Lennox, Babcock and Wilcox, Westinghouse, Bechtel, Phillips Petroleum, and many others. These examples illustrate Sandia's on-going commitment to working in energy R&D and transferring what we learn to industry. We also have extensive technology transfer to other commercial sectors including health care, materials, chemicals, and others.

We are improving our technology transfer.

Now let's address how we can improve our Sandia technology transfer to New Mexico firms. We are proposing an increased interaction through the three research universities in New Mexico, the major non-academic research centers, and business incubators by forming a consortium that will streamline technology commercialization through reducing the administrative roadblocks. A consortium will encourage rapid pooling of resources of all the members. For instance, there would be a framework for disclosing ideas for patent disclosures, copyrights, and know how in the early phases of discovery. Laboratory facilities and staff consulting would be easily shared for developing consortium projects. Any license fees or royalties would be distributed to the institutional participants on particular projects, and would be applied, for instance, to more research and inventor incentive awards.

We believe that local consortia are useful means to encourage technology commercialization especially with formation of start-up businesses.

The Senate can help.

Senate Bill 1480 contains many provisions that will help in this process, such as allowing the laboratories to take possession of patents and copyrights and promptly negotiate licensing contracts in a timely manner. The traditional policies on information management have concentrated on protecting data only for military security. This new bill will encourage more entrepreneurship in the laboratories and it will help to selectively direct information to help preferentially U.S. industry.

Gentlemen, I appreciate the opportunity again to speak with you on these important issues.

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